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NATIONAL DAM INSPECTION PROGRAM. BEAVER CREEK DAM (SCS PA 433).--ETC(U)
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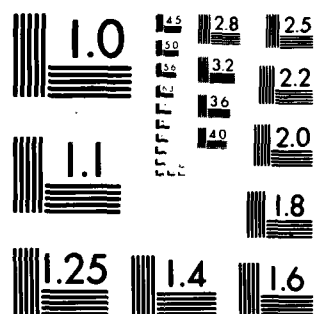
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6 National Dam Inspection Program.
BEAVER CREEK DAM
(SCS PA 433).

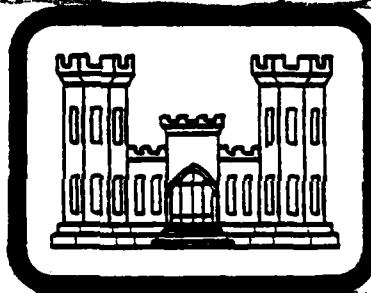
~~CHESTER COUNTY, PENNSYLVANIA~~

(NDS I.D. Number PA 88903,
DER I.D. Number 15-301)



PHASE I INSPECTION REPORT,
NATIONAL DAM INSPECTION PROGRAM

10 Mary F. / Beck
John H. / Frederick, Jr.



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Prepared by:

WOODWARD-CLYDE CONSULTANTS
5120 Butler Pike
Plymouth Meeting, Pennsylvania 19462

Submitted to:

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

11 APR 1980

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James

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to expeditiously identify those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, testing and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for more detailed studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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**PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM**

Name of Dam: Beaver Creek Dam
(SCS PA 433)
County Located: Chester County
State Located: Pennsylvania
Stream: Beaver Creek
Coordinates: Latitude 40° 1.8'
Longitude 75° 47.0'
Date of Inspection: March 25, 1980

Beaver Creek Dam is owned by the Chester Water Resources Authority. The dam was built as part of a flood control plan consisting of six dams on the East Branch Brandywine Creek Watershed.

The dam and its appurtenant facilities are considered to be in good condition. The dam is classified as an "Intermediate" size structure with a "High" hazard classification, consistent with the dam's location above the communities of Bondsville, Fisherville and Downingtown.

In accordance with criteria established by Federal (OCE) Guidelines, the recommended spillway design flood for this "Intermediate" size dam and "High" hazard classification is the Probable Maximum Flood (PMF). The Soil Conservation Service designed this dam as a Class C structure, which also requires that the spillway systems be designed to pass the PMF. The original flood routing is included in Appendix D, and the spillway classification for this structure is considered to be "Adequate".

It is recommended that the following measures be undertaken as soon practical.

1. Future erosion at the junction of the embankment and right abutment should be prevented by the use of graded rock and bedding material.
2. Debris should be removed periodically from the intake channel immediately upstream of the riser pond drain invert orifice.
3. The pond drain gate should be made operational.

BEAVER CREEK DAM, NDS I.D. No. PA 00903

Because of the location of the dam upstream of Bondsville, Fisherville and Downingtown, a formal procedure of observation and warning during periods of high precipitation is being developed. It is reported that this warning procedure will include monitoring of the dam during periods of high precipitation and a method of warning and evacuating downstream residents along the creek, if necessary.

Access to the dam is through Fernvue Farms from the left abutment, which requires crossing the emergency spillway, which may be flooded during an emergency. Direct access to the dam is provided through a locked gate in a chain link fence at the right abutment of the dam. The Chester Water Resources Authority presently does not have a key to the gate. Therefore, it is suggested that Chester Water Resources Authority be provided a key to the gate.

Mary F. Beck
Mary F. Beck, P.E.
Pennsylvania Registration 27847E
Woodward-Clyde Consultants

4/29/80
Date

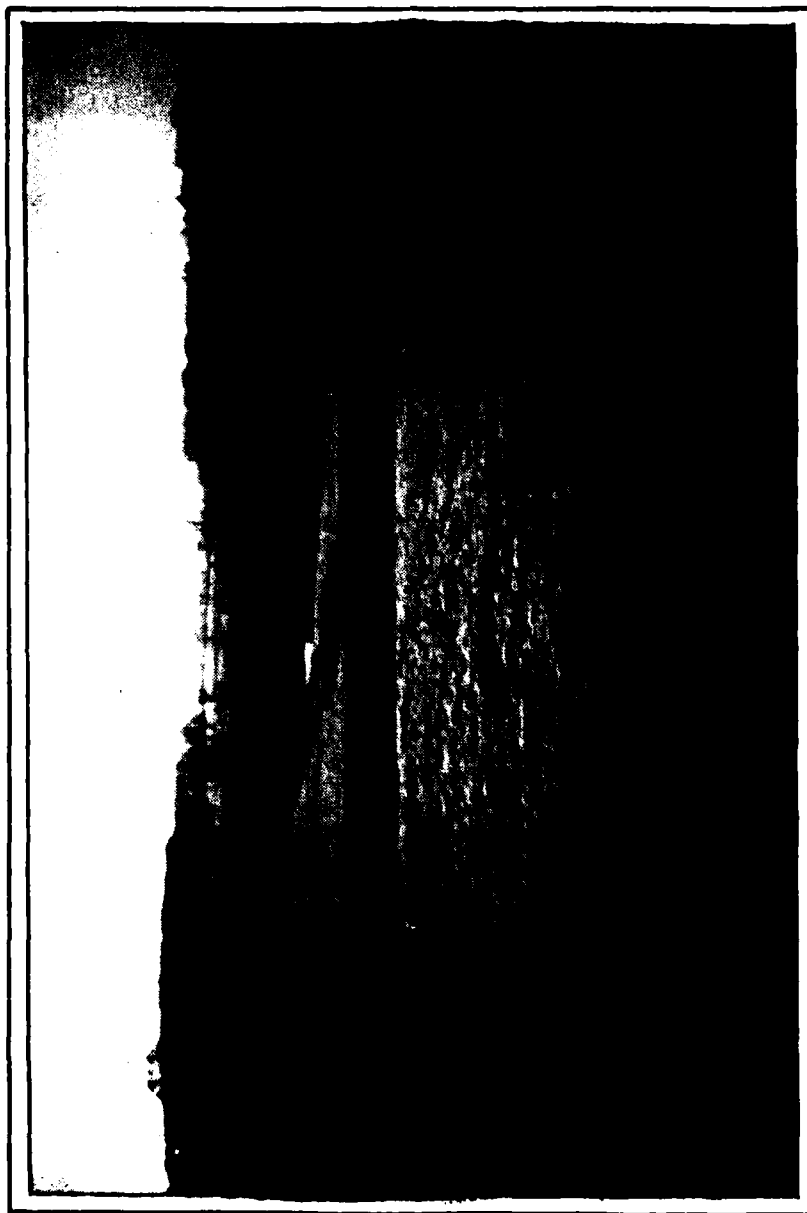
John H. Frederick, Jr.
John H. Frederick, Jr., P.E.
Maryland Registration 7301
Woodward-Clyde Consultants

4/29/80
Date

APPROVED BY:

James W. Peck
JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

21 May 80
Date



OVERVIEW
BEAVER CREEK DAM (SCS PA 433), CHESTER COUNTY, PENNSYLVANIA

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
BEAVER CREEK DAM
(SCS PA 433)
NATIONAL ID #PA 00903
DER #15-301

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Beaver Creek Dam is a zoned earth embankment with a relatively impervious cutoff trench beneath the embankment centerline. A typical plan and section of the dam are shown on Plates 3 and 4, Appendix E. The dam is approximately 1,400 feet long and the height, measured from the relocated stream bed at the downstream toe to the crest, is about 36 feet. Embankment fill was obtained from within the reservoir and from the emergency spillway excavation. Zone 1 materials, classified as low plasticity clays and silts, were used as impervious fill in the core trench, as an upstream section and as a blanket under the upstream half of the dam; see Plate 4, Appendix E. Zone 2 materials, classified as silty sands, form the bulk of the embankment. The cutoff trench is 12 feet wide at the bottom and has side slopes of 2H:1V. About one-third of the way from the downstream toe to the dam centerline is a drain trench. Seepage intercepted by the drain trench is collected in a perforated drain pipe and discharged through the side walls of the impact basin at the downstream toe. The downstream slope is 3H:1V and the upstream slope is also 3H:1V with a 10 foot wide berm at approximately elevation 487.1, the design normal/sediment pool elevation. The crest is 14 feet wide with a design settled fill elevation of 510.8. A gravel road crosses the emergency spillway and dam breast, as shown on Plate 3.

The principal spillway, located at centerline Station 16 + 50, is composed of a single-stage drop inlet riser located at the upstream toe of the embankment, a 208 foot long, 30 inch diameter reinforced concrete pressure pipe, and an impact basin at the downstream toe. The crest of the riser weirs is at elevation 486.6, and the conduit outlet invert and impact basin end sill elevation is 474.5. The pond drain, a two foot diameter orifice at elevation 477.5, is gated on the outside, or upstream side, of the riser. The discharge conduit has seven reinforced concrete anti-seepage collars, located as shown on Plate 8, Appendix E.

The emergency spillway is at the left abutment. The grass lined emergency spillway channel is 225 feet wide, with a 30 foot long level section at elevation 504.8. The emergency spillway side slopes are both 3H:1V. The emergency spillway is excavated through earth, and the maximum discharge slope is three percent. Flow from the emergency spillway joins with principal spillway discharge about 700 feet below the dam.

* b. Location. The dam is located on Beaver Creek in East Brandywine Township, Chester County, Pennsylvania. The dam site is located approximately 3.4 miles northwest of the intersection of U.S. Routes 322 and 30. The dam site and reservoir are shown on USGS Quadrangle entitled "Wagontown, Pennsylvania" at coordinates N 40° 1.8' W 75° 47.0'. A regional location plan of Beaver Creek Dam is enclosed as Plate 1, Appendix E.

c. Size Classification. The dam is classified as an "Intermediate" size dam by virtue of its 36 foot height and 1,468 acre-feet total storage capacity.

d. Hazard Classification. A "High" hazard classification is assigned consistent with the potential for extensive property damage and possible loss of life downstream along Beaver Creek.

e. Ownership. The dam is located on land leased from Fairvue Farms by Chester Water Resources Authority. All correspondence should be sent to Mr. David C. Yaeck, Executive Director, Chester Water Resources Authority, Room 314, F & M Building, High & Market Streets, West Chester, Pennsylvania 19380.

f. Purpose of Dam. The purpose of this dam is for flood control. Beaver Creek Dam is one of six proposed or constructed flood control structures located within the East Branch Brandywine Creek Watershed.

g. Design and Construction History. Beaver Creek Dam was constructed as a flood retarding structure under the provisions of the Watershed Protection and Flood Prevention Act. The Soil Conservation Service (SCS) designed the dam and provided resident engineering and construction inspection services. Construction began in the June 1974. The dam was completed in October 1975, and final inspection was scheduled for November 13, 1975. In January 1976, the pond drain gate was closed.

The SCS project engineer was Mr. Frederick H. Schuetz, who submitted bimonthly construction progress reports to the state in addition to detailed construction records kept by SCS. Construction summary records located in Department of Environmental Resources (DER) files indicate that embankment materials were placed in accordance with specifications. Specifically, all embankment density tests met or exceeded the minimum specified 95 percent of the Standard Proctor Maximum Dry Density (ASTM D 698).

Land for this dam was leased to the Water Authority rather than sold for fee simple because the Owner wanted to prevent public access to the reservoir. In July 1976, application was made and permission received to open the pond drain gate and convert the structure to a dry dam.

h. Normal Operating Procedures. Under normal operating conditions, the pond drain gate is open, and water flows through the pond drain orifice and through the principal spillway conduit. During a large storm event, excess water would be stored to elevation 486.6, the riser weirs elevation, and thereafter stored to elevation 504.8, when water would be discharged through the emergency spillway at the left abutment.

1.3 Pertinent Data.

A summary of pertinent data for Beaver Creek Dam is presented as follows.

a.	Drainage Area (square miles)	3.1
b.	Discharge at Dam Site (cfs)	
	Maximum Known Flood at Site	Unknown
	At Design High Water	1,225
	At Top of Dam	9,410
c.	Elevation (feet above MSL)	
	Top of Dam	510.8

	Design High Water	506.6
	Emergency Spillway Crest	504.8
	Principal Spillway	
	Weir Crest	486.6
	Pond Drain Inlet Invert	477.5
	Outlet Invert	474.5
	Downstream Toe (low point)	480.3
	Stream at Downstream Toe	474.5
d.	Reservoir (feet)	
	Length at Normal Pool	Dry
	Length at Design High Water	3,750
e.	Storage (acre-feet)	
	Sediment Storage	43
	To Emergency Spillway Crest	843
	To Top of Dam	1,464
f.	Reservoir Surface (acres)	
	Normal Pool	Dry
	Sediment Pool	11
	At Top of Dam	120
g.	Dam Data	
	Type	Zoned earth
	Volume	106,000 cubic yards
	Length	1,370 feet
	Maximum Height *	36 feet
	Top Width	14 feet
	Side Slopes	
	Upstream	3H:1V
	Downstream	3H:1V
	Cutoff	Cutoff trench under dam centerline
	Grout Curtain	None
h.	Principal Spillway	
	Type	Single stage reinforced concrete drop inlet riser, 30 inch conduit and impact basin at downstream toe

* Measured from dam crest to the relocated stream bed at the downstream toe.

Reservoir Drain	24 inch orifice in riser
Elevations (feet)	
Weirs	486.6
Pond Drain Inlet Invert	477.5
Conduit Outlet Invert and Impact Basin End Sill	474.5
Energy Dissipator	Impact basin at downstream toe

i. Emergency Spillway
Type

Width
Side Slopes

Grass lined trapezoidal channel excavated through earth
225 feet
3H:1V

SECTION 2 ENGINEERING DATA

2.1 Design.

a. Data Available. A summary of engineering data for Beaver Creek Dam is attached as Appendix B. Engineering data available for review is contained in a several hundred page design folder prepared by the United States Department of Agriculture, Soil Conservation Service (SCS), and a 33-page set of as-built drawings from the Department of Environmental Resources (DER) files. These drawings were prepared by the SCS. Other documentation included miscellaneous letters, correspondence and bimonthly construction reports prepared by the SCS resident engineer.

b. Design Features. Principal design features of Beaver Creek Dam are illustrated on the plans and profiles enclosed in Appendix E as Plates 2 through 8. These plates were reproduced from the as-built drawings. A detailed description of the design features is also presented in Section 1.2, paragraph a, and pertinent data relative to the structure is presented in Section 1.3.

2.2 Construction.

Known details of construction are presented in Section 1.2, paragraph g. Construction records reviewed for this project were obtained from DER files located in Harrisburg, Pennsylvania.

2.3 Operational Data.

There are no operational records maintained.

2.4 Evaluation.

a. Availability. All engineering data evaluated and reproduced for this report were provided by the Pennsylvania DER or by SCS.

b. Adequacy. The data included in the state files, supplemented with data obtained from the Owner, are considered adequate to evaluate the dam and appurtenant structures.

c. Validity. There is no reason to question the validity of this data.

SECTION 3 VISUAL INSPECTION

3.1 Findings.

a. General. Observations and comments of the field inspection team are contained in the checklist enclosed herein as Appendix A, and are summarized and evaluated as follows. In general, the dam and its appurtenant structures are considered to be in good condition. At the time of the inspection (March 25, 1980), stream flow was passing through the principal spillway, and the reservoir level was above normal because of a previous rainfall, preventing access to the riser. On April 25, the reservoir level was down, permitting access to the riser.

b. Dam. During the visual inspection, there were no indications of distortion in alignment or grade that would be indicative of movement of the embankment or foundation. Crownvetch cover on both the upstream and downstream slopes, although dormant, is considered to be in good condition. A minor amount of first year weedy vegetation was noted. The upstream embankment below the berm was soft and had a small amount of rainwater standing on it. The dam crest was in good condition, with no standing rainwater. No erosion gullies were noted on either the upstream or downstream embankments, or over the edge of the crest. Rainwater was standing in the area beyond the downstream toe of the embankment, which is flat.

The vertical/horizontal alignments were checked and found to be in satisfactory condition across the emergency spillway control section and along the dam crest. The vertical alignment is shown on sheet 5B, Appendix A. The upstream junction of the right abutment and embankment is in good condition, with no paths or erosion noted. A diversion channel is constructed about one-third of the distance down from the top of the dam at the downstream junction of the embankment and right abutment to divert surface runoff away from the toe of the dam. A gully is starting to form in the junction below this diversion, with a scarp about 4 or 5 inches high. The junctions between the embankment and left abutment appear to be in good condition, although paths have been worn through the vegetation. The depth of the water in the impact basin was above the invert of the embankment drain outlets, preventing determination of whether the embankment drains were flowing. The second visit to the site indicated that the water level in the impact basin is normally above the embankment drain inverts.

c. Appurtenant Structures.

1. Principal Spillway. The riser is located at the upstream toe of the embankment. Exposed portions of the riser were inspected and evaluated to be in good condition with no signs of excessive concrete deterioration, spalling or other structural deficiencies or defects. The trash rack channels were bent by ice during the winter of 1977-1978. Debris was noted in the water around the riser, and should be removed during routine maintenance. The interior of the intake riser was inspected and the pond drain gate was exercised during the second visit to the site. The pond drain gate was closed and could not be opened, impounding water. The Soil Conservation Service is providing the Owner with information to order replacement parts for repair.

The exposed portions of the impact basin were inspected and found to be in good condition. The outlet channel was inspected and observed to be in good condition with no excessive erosion or bank undercutting.

2. Emergency Spillway. The hay lined emergency spillway at the left abutment was inspected and found to be stable and in good condition. The side slopes are well vegetated and appear to be in good condition. The outside spillway slope has an occasional area of gravel at the surface, with no vegetation over it. The channel bottom is densely vegetated. At the time of the inspection, it appeared that a piece of farm equipment had been moved through the emergency spillway adjacent to the outside wall, making cuts through the vegetation and root mass. Farm equipment should not be permitted to damage the emergency spillway.

d. Reservoir. At the time of the inspection, the water level was about five feet above the pond drain invert. The permanent pool area had previously been cleared of all vegetation, but when the dam was converted to a dry structure, the permanent pool area was allowed to go back to natural vegetation. Above the permanent pool area, the reservoir side slopes are moderate and vegetated with grass and trees. Some debris was noted along the shoreline, which could partially block flow through the principal spillway.

e. Downstream Channel. As shown on Plate 1, Appendix E, Beaver Creek flows in a southeast direction, and enters the East Branch Brandywine Creek above Downingtown, about six miles below the dam. About two river miles below the dam is the small village of Bondsville. At Bondsville, Beaver Creek enters a small pond formed by a dam. Between Beaver Creek Dam and Bondsville are four or five houses which would be damaged

in the event of failure. At Bondsville, additional homes and a factory, presently unoccupied, would be damaged in the event of failure. Farther downstream in Fisherville are at least five more homes subject to damage in the event of failure. The Brandywine Creek Watershed Work Plan identifies Bondsville and Downingtown as areas benefited by construction of Beaver Creek Dam. This clearly justifies a "High" hazard classification.

3.2 Evaluation.

Inspection of the dam and appurtenant facilities disclosed no evidence of apparent past or present movement that would indicate existing instability of the dam, principal or emergency spillways. Exterior and interior portions of the principal spillway were inspected and observed to be in good condition. The pond drain gate is presently inoperable and should be repaired. The principal spillway discharge channel is in good condition with no excessive bank undercutting or erosion. The emergency spillway channel and area below the dam were observed to be in good condition. The reservoir shoreline contains some debris which could float and partially clog the principal spillway. The crest of the dam is in good condition with no wet or poorly drained areas. The upstream and downstream slopes are well vegetated with Crownvetch and judged to be in good condition.

Although the erosion between the downstream embankment and right abutment is still fairly minor in nature, it is recommended that graded rock and bedding material be installed to prevent further damage.

SECTION 4 OPERATIONAL PROCEDURES

4.1 Procedures.

Operational procedures are discussed in Section 1.2. Operation of the dam does not require a dam tender. Under normal conditions, flow discharges through the pond drain orifice and through the 30 inch reinforced concrete conduit at the base of the embankment. Excess water is stored first to the riser weir elevation and then to the crest of the emergency spillway. According to the Owner's representative, water has never flowed over the emergency spillway. There are written operation and maintenance procedures for this structure.

4.2 Maintenance of the Dam.

Fernvue Farms is under contract to the Chester Water Resources Authority to provide maintenance for the embankment and emergency spillway.

4.3 Maintenance of Operating Facilities.

Maintenance of these facilities includes cleaning debris from the intake systems and exercising and lubricating the pond drain gate. Maintenance is provided by employees of Chester Water Resources Authority.

4.4 Warning Systems In Effect.

The executive director of Chester Water Resources Authority indicated that a warning system is being developed for the entire Chester County as part of the National Weather Service flood warning network. Evacuation procedures are being developed for downstream residences in the event of an emergency.

4.5 Evaluation.

It is judged that the current operating procedure, which does not require a dam tender, is a realistic means of operating the relatively simple control facilities at Beaver Creek Dam.

Direct access to the dam is prevented by a locked gate in a chain link fence at the right abutment of the dam. The Chester Water Resources Authority presently does not have a key to the gate. Access to the dam is through Fernvue Farms from the left abutment, which requires crossing the emergency spillway, which may be flooded during an emergency. Therefore, it is suggested that Chester Water Resources Authority be provided a key to the gate.

SECTION 5 HYDROLOGY/HYDRAULICS

5.1 Evaluation of Features.

a. Design Data. The complete folder of SCS design calculations was reviewed, and portions of this folder are presented in Appendix D.

The watershed is about 2.6 miles long and averages one mile wide, having a total area of approximately 3.1 square miles. Elevations range from 760 in the upper reaches to 477.5 at the pond drain elevation. The watershed is predominantly open/farmland with less than five percent residential development. Residential development can be expected to continue slowly within the watershed.

In accordance with criteria established by Federal (OCE) Guidelines, the recommended spillway design flood for this "Intermediate" size dam and "High" hazard classification is the Probable Maximum Flood (PMF). The Soil Conservation Service designed this dam as a Class C structure, which also requires that the spillway systems be designed to pass the PMF.

b. Experience Data. There are no records of reservoir levels kept for this dam. While rainfalls are not measured within the Beaver Creek Watershed, rainfall measurements are maintained within the Brandywine Creek Watershed as part of the National Weather Service's national flood warning network. There are no estimates or records of previous high water levels beyond a minimum high water elevation of 491+, the top of the riser slab.

c. Visual Observations. On the date of the inspection, there were no conditions observed that would indicate a reduced spillway capacity during an extreme event other than an accumulation of debris in the water upstream of the riser. Observations regarding the condition of the downstream channel, spillways and reservoir are located in Appendix A and discussed in greater detail in Section 3.

d. Overtopping Potential. The dam was designed to pass the PMF without overtopping. The PMF inflow hydrograph and flood routing are presented in Appendix D. This information was reviewed, evaluated and judged to be adequate. In summary, the peak inflow was computed as 11,761 cfs resulting from a six-hour storm with 26.0 inches of rainfall, producing

21.8 inches of runoff. The storm was routed through the reservoir to produce a peak discharge of 9,160 cfs and a maximum water level elevation of 510.7 just below the top of the dam. Spillway systems for this dam are considered to be "Adequate" as the dam will pass the PMF without overtopping.

e. Downstream Conditions. Beaver Creek Dam is one of six planned or constructed flood control structures on the East Branch Brandywine Creek. The combined effect of the structures is estimated (by the Watershed Work Plan) to reduce flooding in Downingtown resulting from a 100 year event from seven feet above flood stage to two feet. In addition to providing relief from flooding in Downingtown, Beaver Creek Dam affords protection to the areas of Bondsville and Fisherville, located along Beaver Creek above Downingtown. There are about ten homes built near Beaver Creek subject to damage in the event of a dam failure, justifying a "High" hazard classification.

SECTION 6 STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Visual observations detected no evidence of existing or impending embankment instability. Upstream and downstream slopes appear stable, with no surficial slides or other indications of deep-seated instability. Both the upstream and downstream slopes are well vegetated with Crownvetch and appear to be in good condition. There were no exterior signs or other evidence to indicate that the internal drainage system was not operating properly. It is noted, however, that during this inspection, the embankment was not retaining a significant head of water, which could affect the internal drainage system, and it is also noted that, at the time of the inspection, the tailwater in the impact basin was higher than the discharge invert elevation of the embankment drains.

Wet areas and standing rainwater were observed on the upstream embankment below the berm and downstream beyond the toe of the dam.

Exposed portions of the principal spillway were inspected and judged to be in good condition. The emergency spillway was also inspected and assessed to be in good condition.

b. Design and Construction Data. Design documentation is very complete and a several hundred page design folder prepared by the Soil Conservation Service (SCS) was reviewed for this investigation. Data included in these files are a foundation report containing permeability test results, shear strength test results and a stability analysis, structural calculations for the principal spillway and a complete set of hydrologic/hydraulic calculations. Portions of the hydrologic/hydraulic section are presented in Appendix D. Principal features of this structure are presented on the drawings located in Appendix E. Also included in the design folder are a complete set of specifications and an estimate of the quantity of materials used in the embankment.

Stability analyses were performed by SCS using the Swedish circle method and the wedge method. The conditions analyzed included rapid drawdown from elevation 501.7 on the upstream slope and steady seepage without embankment drainage on the downstream slope. The soil strength parameters were

determined from a direct shear test and a consolidated-undrained triaxial compression test on undisturbed samples of foundation soils and one triaxial test on compacted embankment soil. The upstream slope was assumed to be 3H:1V and the downstream slope 2.5H:1V. The maximum embankment height was assumed to be 33.8 feet.

The minimum factors of safety computed in the stability analyses were 1.69 for the upstream slope and 1.49 for the downstream slope. According to Corps of Engineers criteria, EM 1110-2-1902, these values are acceptable. The maximum height of the dam considered is somewhat less than the actual maximum height. However, since the dam was constructed with a 3H:1V downstream slope containing embankment drains, and since the elevation of the steady pool with the pond drain closed is only 486.6, it is assessed that the stability of the dam is adequate.

c. Operating Records. There are no operational records for this structure.

d. Post-Construction Changes. There are no reports nor is there any evidence that modifications were made to this dam.

e. Seismic Stability. The dam is located in Seismic Zone 1. Normally it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake conditions. As the dam is assessed to be stable under static loading conditions, it can reasonably be assumed to be stable under seismic loading conditions.

SECTION 7 ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Evaluation. Visual inspection and review of design and construction documentation indicate that the dam, foundation and appurtenant structures of Beaver Creek Dam are in good condition.

In accordance with criteria established by Federal (OCE) Guidelines, the recommended spillway design flood for this "Intermediate" size dam and "High" hazard classification is the Probable Maximum Flood (PMF). The Soil Conservation Service designed this dam as a Class C structure, which also requires that the spillway systems be designed to pass the PMF.

Hydrologic and hydraulic computations presented in Appendix D indicate the structure will pass the Probable Maximum Flood without overtopping. Therefore, the spillway systems of this structure are considered to be "Adequate".

b. Adequacy of Information. Information available for this investigation was sufficiently adequate to evaluate the structure and hydraulic aspects of the dam.

c. Urgency. It is recommended that suggestions presented in Section 7.2 be implemented as specified.

7.2 Remedial Measures.

a. Facilities. It is recommended that the following steps be taken as soon as practical.

1. Future erosion at the junction of the embankment and right abutment should be prevented by the use of graded rock and bedding material.
2. Debris should be removed periodically from the intake channel immediately upstream of the riser pond drain invert orifice.
3. The pond drain gate should be made operational.

b. Operation and Maintenance Procedures. Chester Water Resources Authority has a written operation and maintenance manual for this dam. A county wide written warning procedure is being developed. It is reported that this warning procedure will include monitoring of the dam during periods of high precipitation and a method of warning and evacuating residents downstream along the creek, if necessary.

Direct access to the dam is provided through a locked gate in a chain link fence at the right abutment of the dam. The Chester Water Resources Authority presently does not have a key to the gate. Access to the dam is through Fernvue Farms from the left abutment, which requires crossing the emergency spillway, which may be flooded during an emergency. Therefore, it is suggested that Chester Water Resources Authority be provided a key to the gate.

APPENDIX

A

CHECK LIST
VISUAL INSPECTION
PHASE I

Sheet 1 of 11

Name Dam Beaver Creek Dam County Chester State Pennsylvania National ID # PA 00903
Type of Dam Earth Hazard Category High
Date(s) Inspection 3/25/80 Weather Cloudy Temperature 30's

Pool Elevation at Time of Inspection 482.7 M.S.L. Tailwater at Time of Inspection N/A M.S.L.

Inspection Personnel:

Mary F. Beck (Hydrologist)
Arthur H. Dvinoff (Geotechnical)
Raymond Lambert (Geologist)

Vincent McKeever (Hydrologist)
John H. Frederick, (Geotechnical)
(4/8/1980)

Mary F. Beck Recorder

Remarks:

Mr. David Yaeck, Executive Director of Chester Water Resources Authority was on site and
provided assistance to the inspection team. Mr. Gary Emmanuel, DFR, Norristown, also
accompanied the inspection team. 4/18/80, Mr. Elbert Wells, SCS District Conservationist,
was on site to operate pond drain gate.

CONCRETE/MASONRY DAMS

Sheet 2 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	N/A	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N/A	
DRAINS	N/A	
WATER PASSAGES	N/A	
FOUNDATION	N/A	

CONCRETE/MASONRY DAMS

Sheet 3 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS, CONCRETE SURFACES	N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	

EMBANKMENT

Sheet 4 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	<i>None observed.</i>	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	<i>None observed.</i>	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	<i>None observed.</i>	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	<i>Good, see Sheet 5B.</i>	
RIPRAP FAILURES		<i>None, riprap around riser and impact basin only.</i>

EMBANKMENT

Sheet 5 of 11

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
------------------------------	---------------------	-----------------------------------

JUNCTION OF EMBANKMENT
AND ABUTMENT, SPILLWAY
AND DAM

Upstream junction of embankment and right abutment in good condition. A small gully has started in the lower two-thirds of the downstream junction. The downstream junction between the embankment and left abutment appears to have a path worn through the vegetation but no damage to the embankment.

ANY NOTICEABLE SEEPAGE

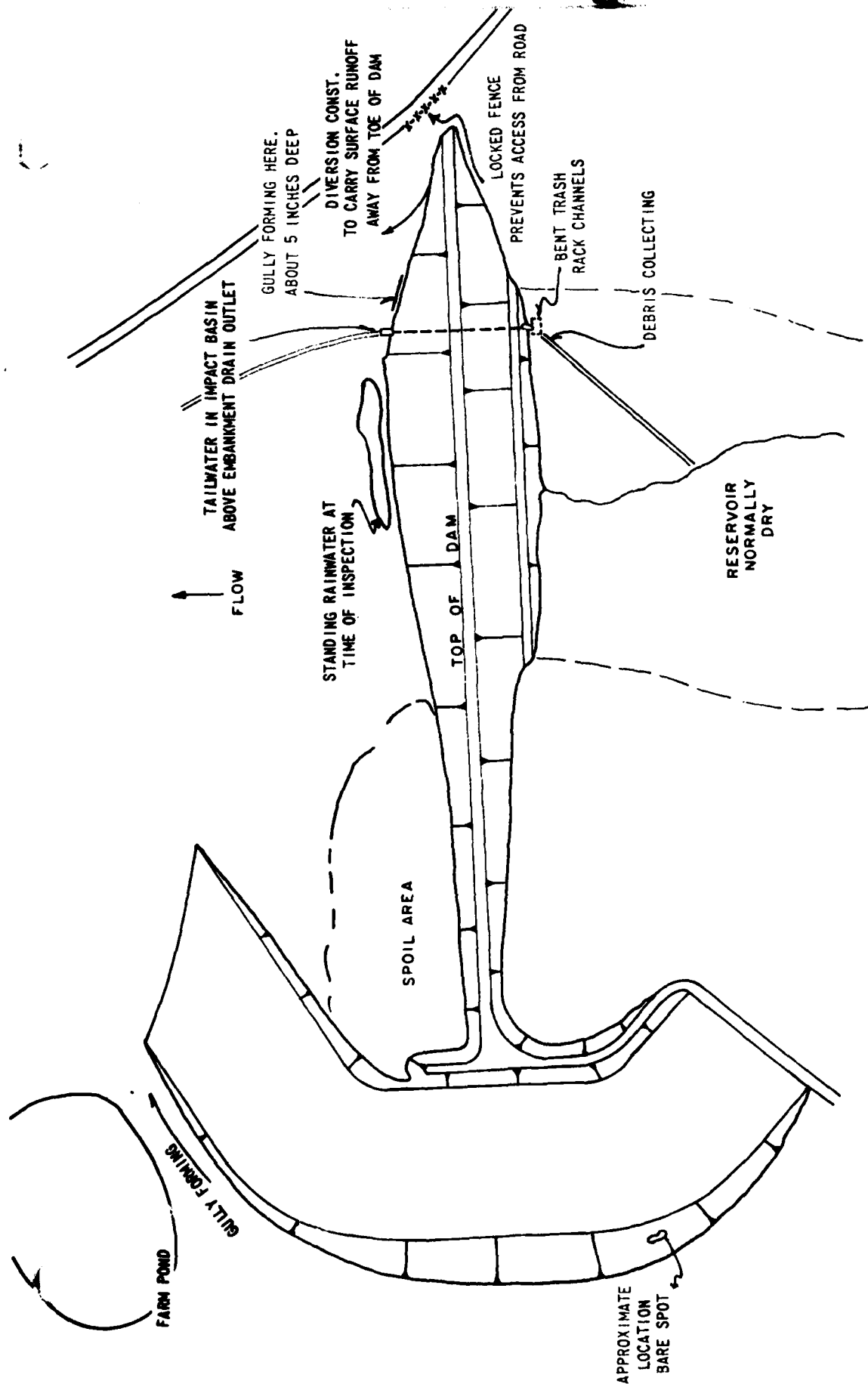
None observed, structure is a dry dam. At the time of inspection, rainwater was ponded beyond the dam toe.

STAFF GAGE AND RECORDER

None

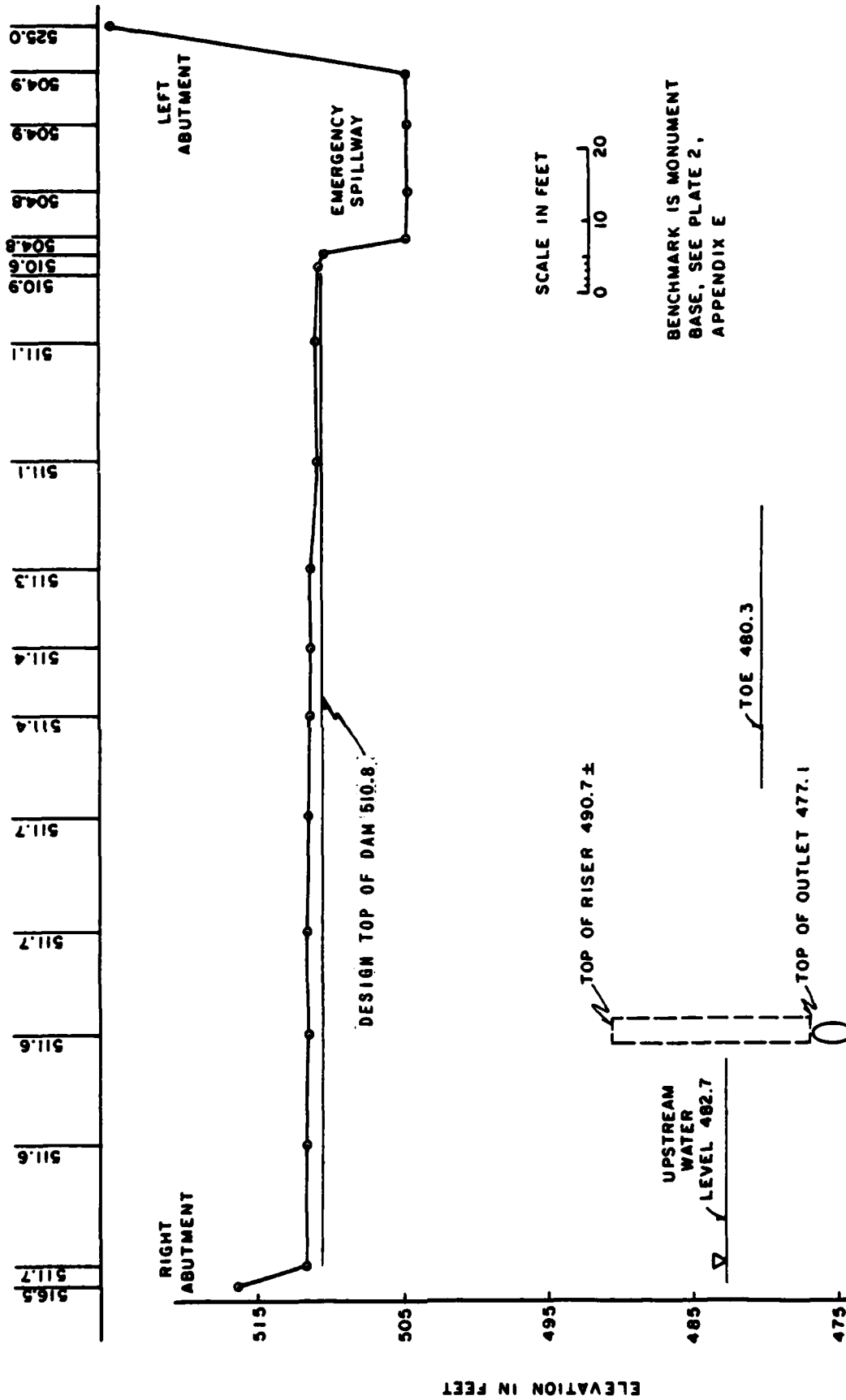
DRAINS

Water level in impact basin was above drain invert and flow from drains could not be detected.



FIELD OBSERVATION PLAN
BEAVER CREEK DAM

SHEET 5A OF 11



PRINCIPAL SPILLWAY
OUTLET WORKS

Sheet 6 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	30 inch conduit at base of dam could not be inspected.	
INTAKE STRUCTURE	Exposed portions appear in good condition with no cracking or spalling noted. It is noted that trash rack channels on the riser have been bent, reportedly by ice during the winter of 1977-78.	
OUTLET STRUCTURE	Exposed portions of the impact basin were inspected and found to be in good condition.	
OUTLET CHANNEL	The outlet channel between the dam and first downstream bridge is in good condition.	
EMERGENCY GATE	High water level prevented access to the riser. On 4/18/1980, the gate was closed and could not be opened.	

EMERGENCY SPILLWAY
UNGATED SPILLWAY

Sheet 7 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

CONCRETE WEIR		
---------------	--	--

	<i>None, spillway is a grass lined trapezoidal channel.</i>	
--	---	--

APPROACH CHANNEL		
------------------	--	--

	<i>Good condition, well vegetated.</i>	
--	--	--

DISCHARGE CHANNEL		
-------------------	--	--

	<i>Good condition, well vegetated.</i>	
--	--	--

BRIDGE AND PIERS		
------------------	--	--

	<i>None</i>	
--	-------------	--

GATED SPILLWAY

Sheet 8 of 11

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

INSTRUMENTATION

Sheet 9 of 11

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION

MONUMENTATION/SURVEYS

None

OBSERVATION WELLS

None

WEIRS

None

PIEZOMETERS

None

OTHER

None

RESERVOIR

Sheet 10 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

SLOPES

Reservoir side slopes are moderate with grass and wood lands.

SEDIMENTATION

*Small amount of sediment at upper end from farming activities.
No effect on computed flood water storage.*

DOWNSTREAM CHANNEL

Sheet 11 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

CONDITION
(OBSTRUCTIONS,
DEBRIS, ETC.)

The channel between the dam and first downstream bridge is in good condition. The channel side slopes are grassed and about 2H:1V.

SLOPES

The valley gradient is about 0.005.

APPROXIMATE NO.
OF HOMES AND
POPULATION

In the first two river miles below the dam are 4 or 5 houses subject to damage in the event of failure of the dam. At Bondsville, 2 miles below the dam, additional homes and an unoccupied factory would be damaged.

APPENDIX

B

NAME OF DAM Beaver Creek Dam
 ID # (SCS PA 433)
PA 00903

CHECK LIST
 ENGINEERING DATA
 DESIGN, CONSTRUCTION, OPERATION
 PHASE I

Sheet 1 of 4

REMARKS

AS-BUILT DRAWINGS

As-built drawings are located in the Owner's files, DER files and Soil Conservation files.

REGIONAL VICINITY MAP

See Plate 1, Appendix E.

CONSTRUCTION HISTORY

See text, Section 1.2.

TYPICAL SECTIONS OF DAM

Sections and plans are included in Appendix E.

OUTLETS - PLAN

DETAILS

See Appendix E.

CONSTRAINTS

DISCHARGE RATINGS

See Appendix D.

RAINFALL/RESERVOIR RECORDS

None

ITEM	REMARKS
DESIGN REPORTS	Located in DER and SCS files.
GEOLOGY REPORTS	Located in DER and SCS files.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Located in Design folder prepared by SCS.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Performed by SCS.
POST-CONSTRUCTION SURVEYS OF DAM	See Appendix A, sheet 5B
BORROW SOURCES	Reservoir area and emergency spillway excavation.

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	None
HIGH POOL RECORDS	None
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION RECORDS	None, although inspection records are maintained by SCS and the Owner.

ITEM	REMARKS
------	---------

SPILLWAY PLAN

SECTIONS

See Appendix E.

DETAILS

OPERATING EQUIPMENT
PLANS & DETAILS

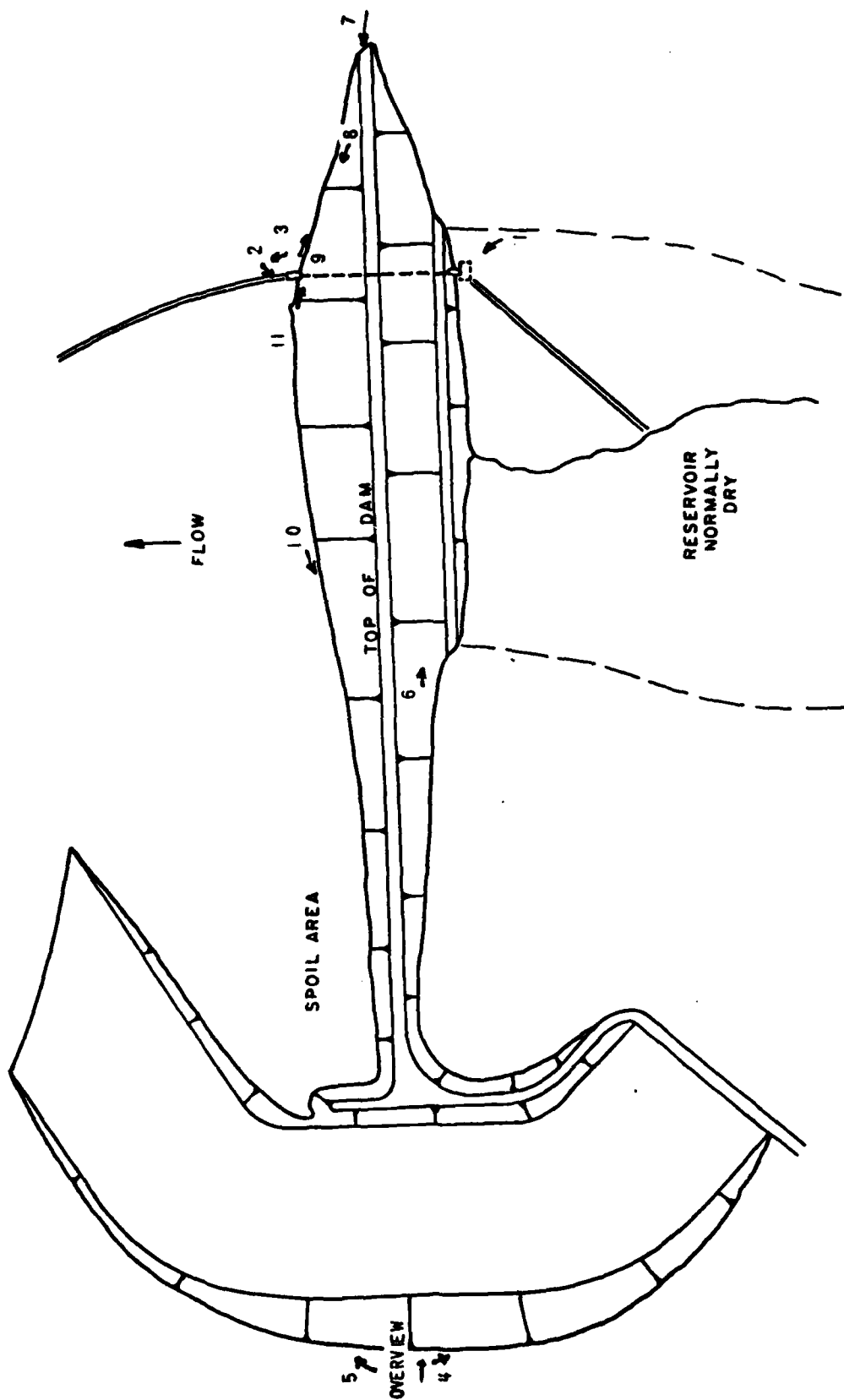
See Appendix E.

MISCELLANEOUS

1. SCS design folder of several hundred pages.
2. 33 sheet set of as-built drawings prepared by SCS.
3. Progress reports by Frederick H. Schueta, Project Engineer.
4. 18 color photographs taken by DER personnel during construction.
5. Post construction inspection reports prepared by SCS.
6. Erosion and Sediment Control Plan prepared by SCS.
7. Correspondence located in DER file.

APPENDIX

C



PHOTOGRAPH LOCATION PLAN

BEAVER CREEK DAM

PLATE C-1



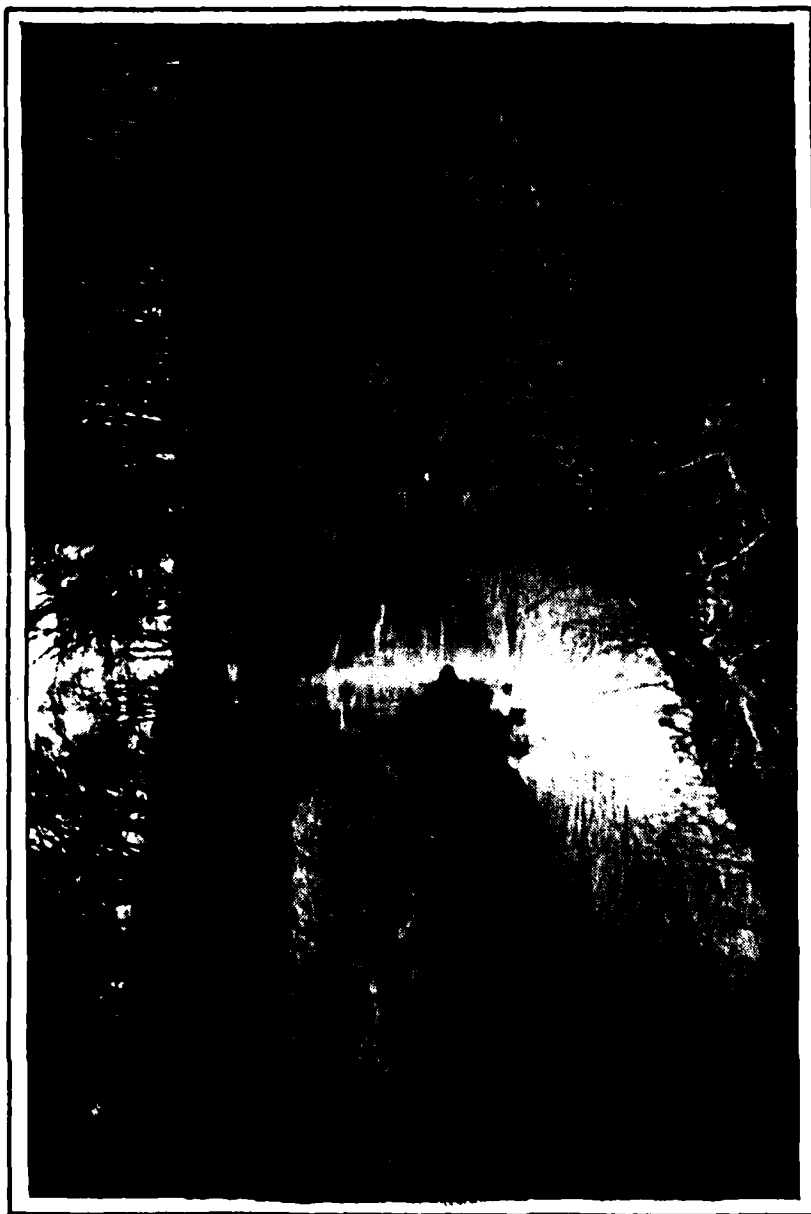
RISER AT UPSTREAM TOE.

PHOTOGRAPH NO. 1



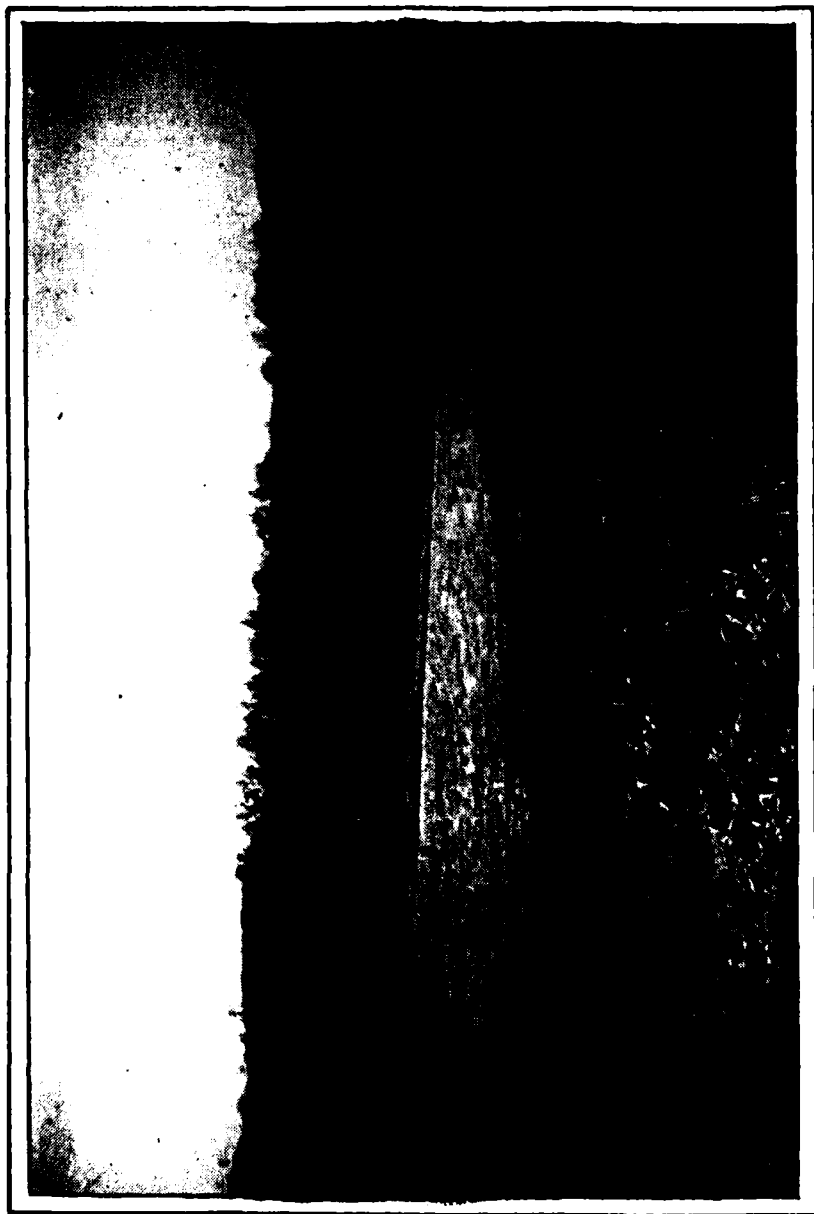
IMPACT BASIN AT DOWNSTREAM TOE.
TAILWATER IS ABOVE EMBANKMENT
DRAIN OUTLET INVERT

PHOTOGRAPH NO. 2



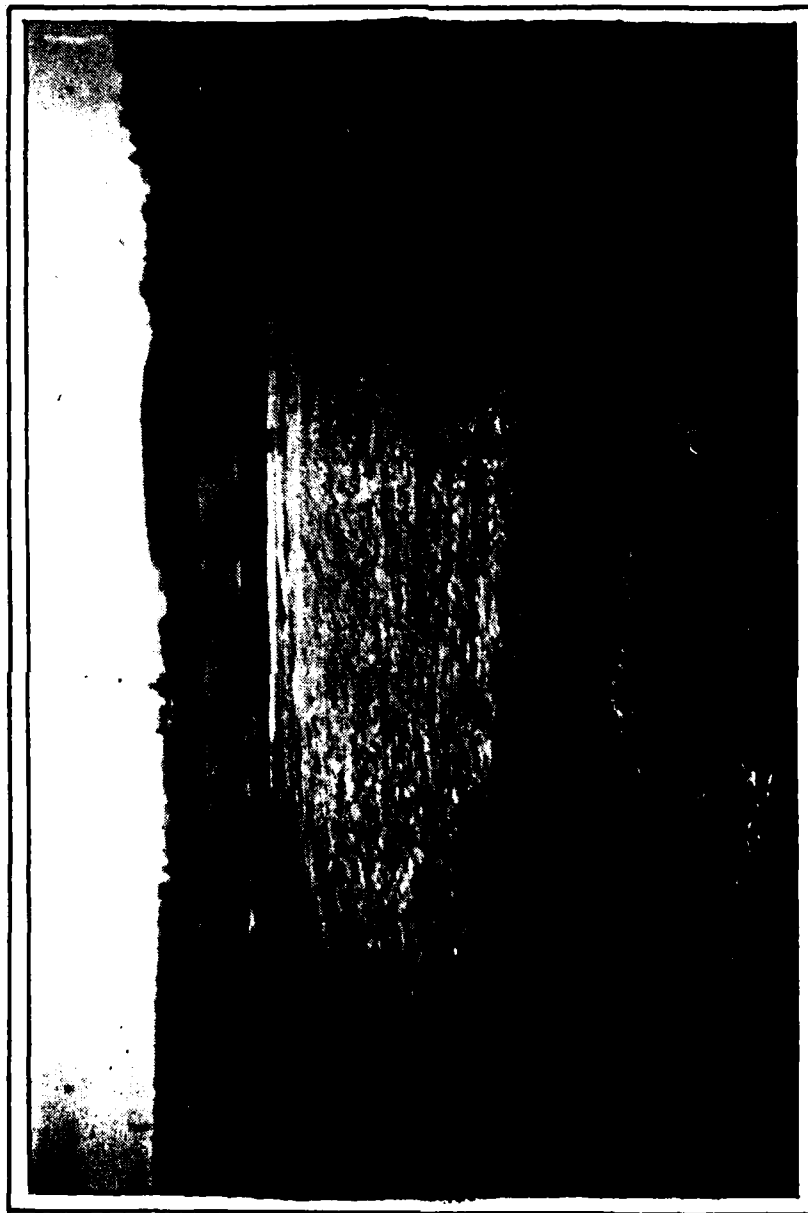
VIEW OF CHANNEL IMMEDIATELY BELOW THE
DAM.

PHOTOGRAPH NO. 3



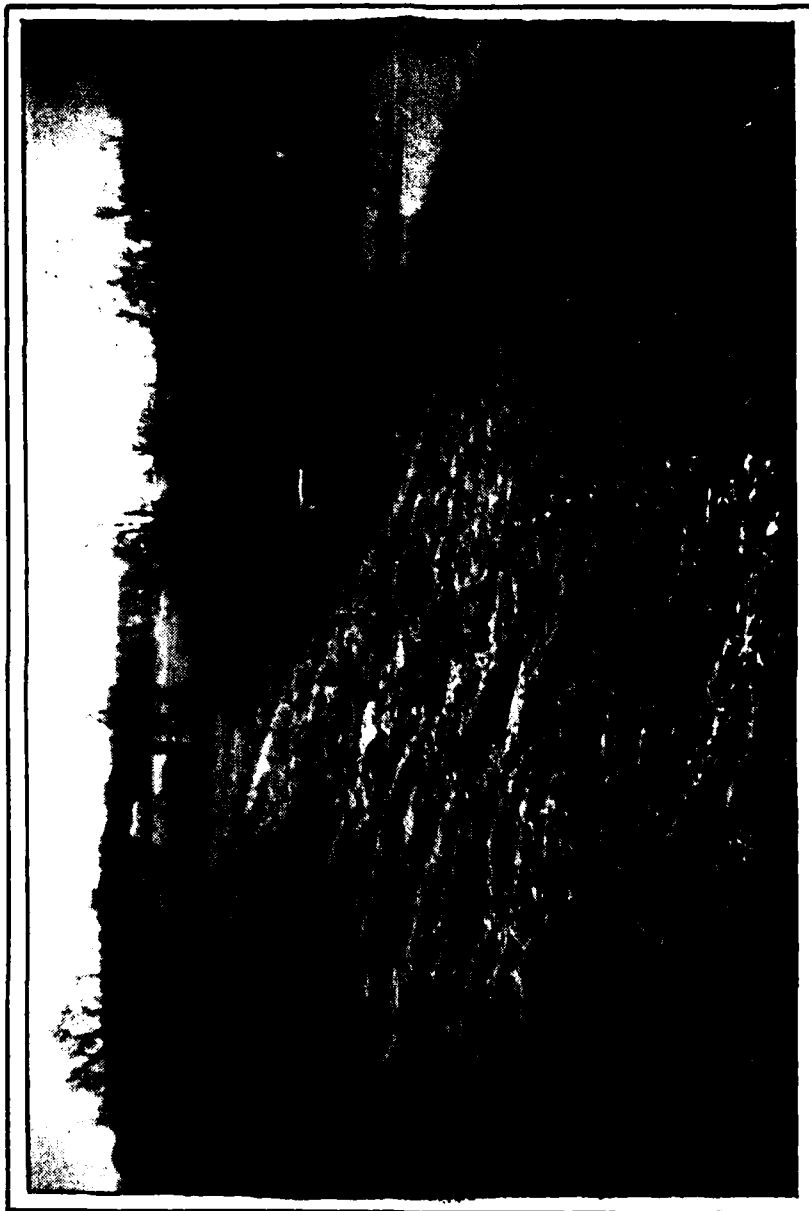
OVERALL VIEW OF EMERGENCY SPILLWAY
LOOKING UPSTREAM.

PHOTOGRAPH NO. 4



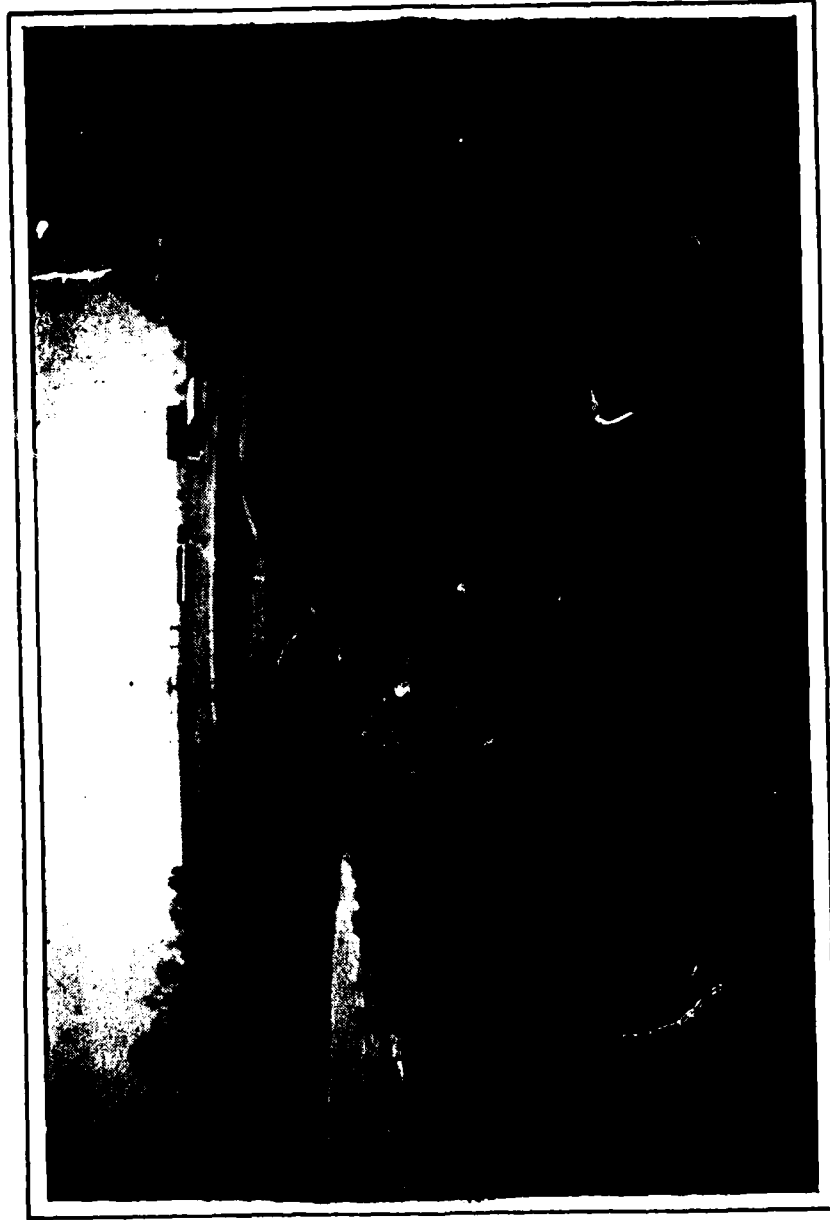
OVERALL VIEW OF EMERGENCY SPILLWAY
LOOKING DOWNSTREAM.

PHOTOGRAPH NO. 5



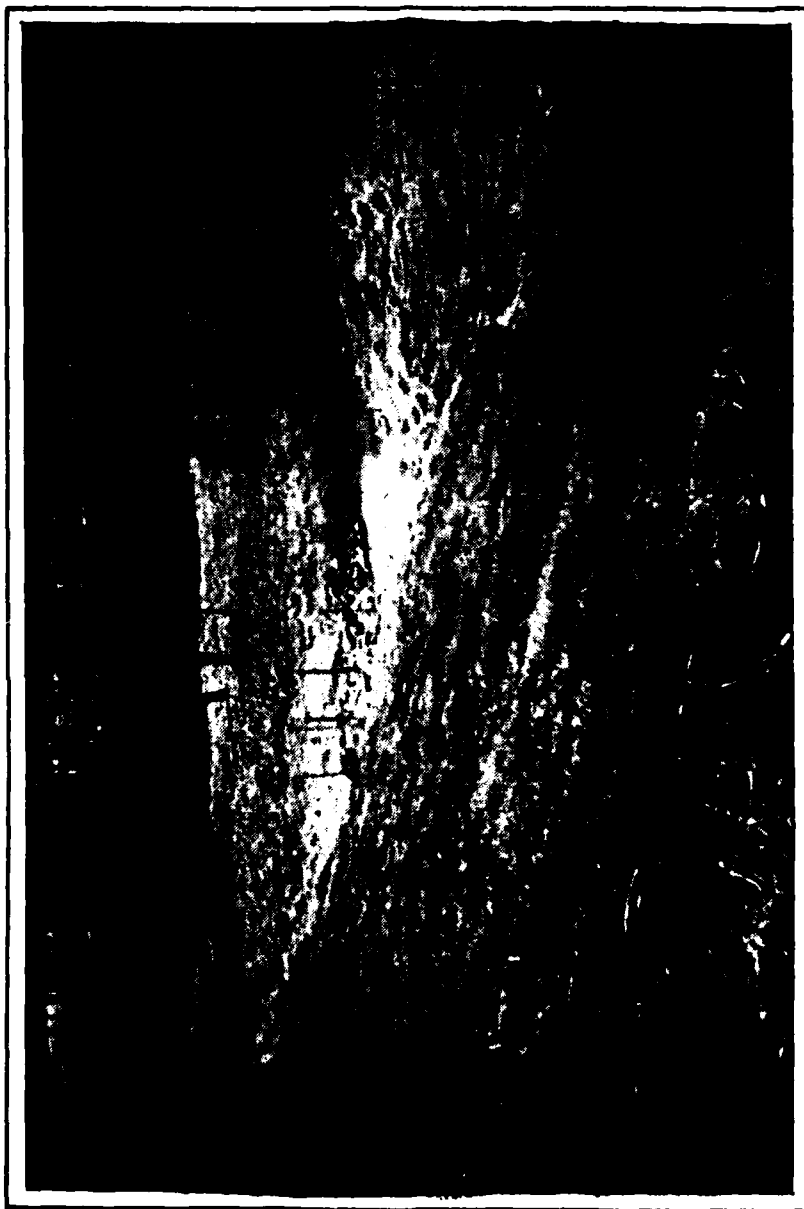
OVERALL VIEW OF UPSTREAM SLOPE.
DORMANT VEGETATION IS IN GOOD
CONDITION.

PHOTOGRAPH NO. 6



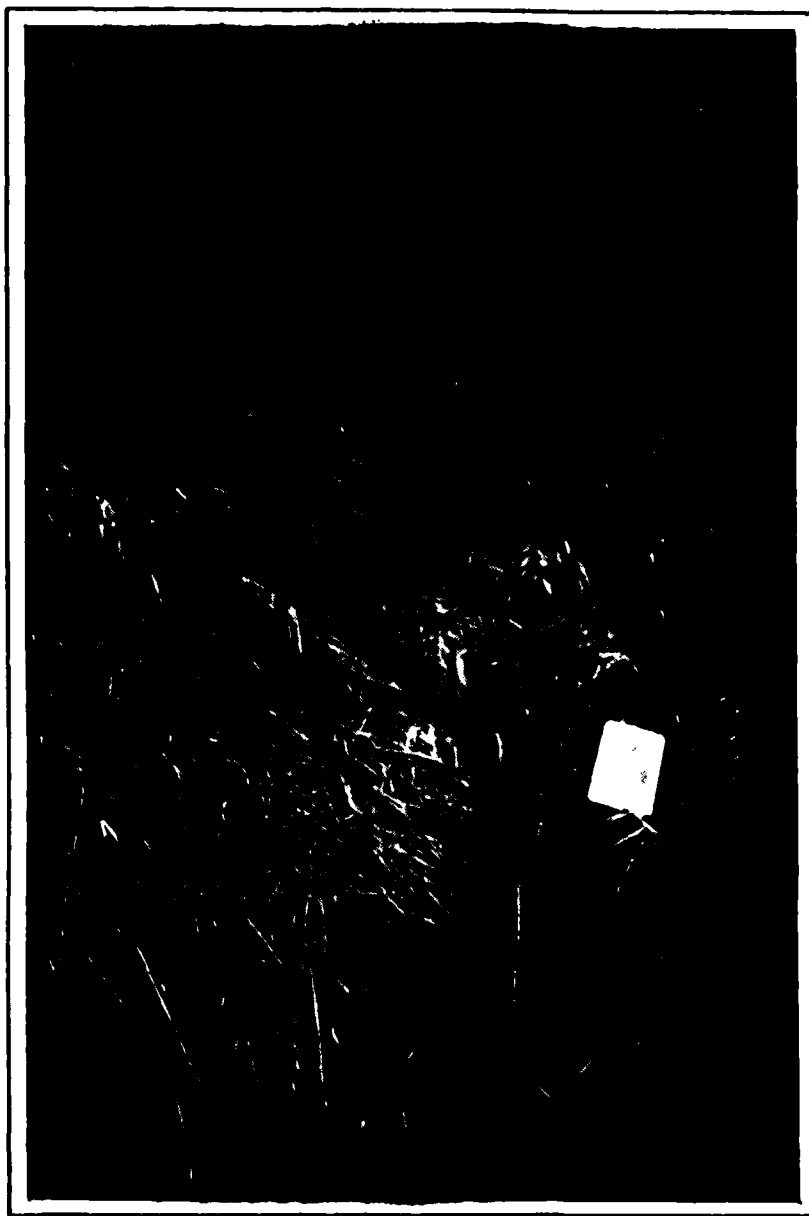
OVERALL VIEW OF CREST PROTECTED BY
GRAVEL ROAD.

PHOTOGRAPH NO. 7



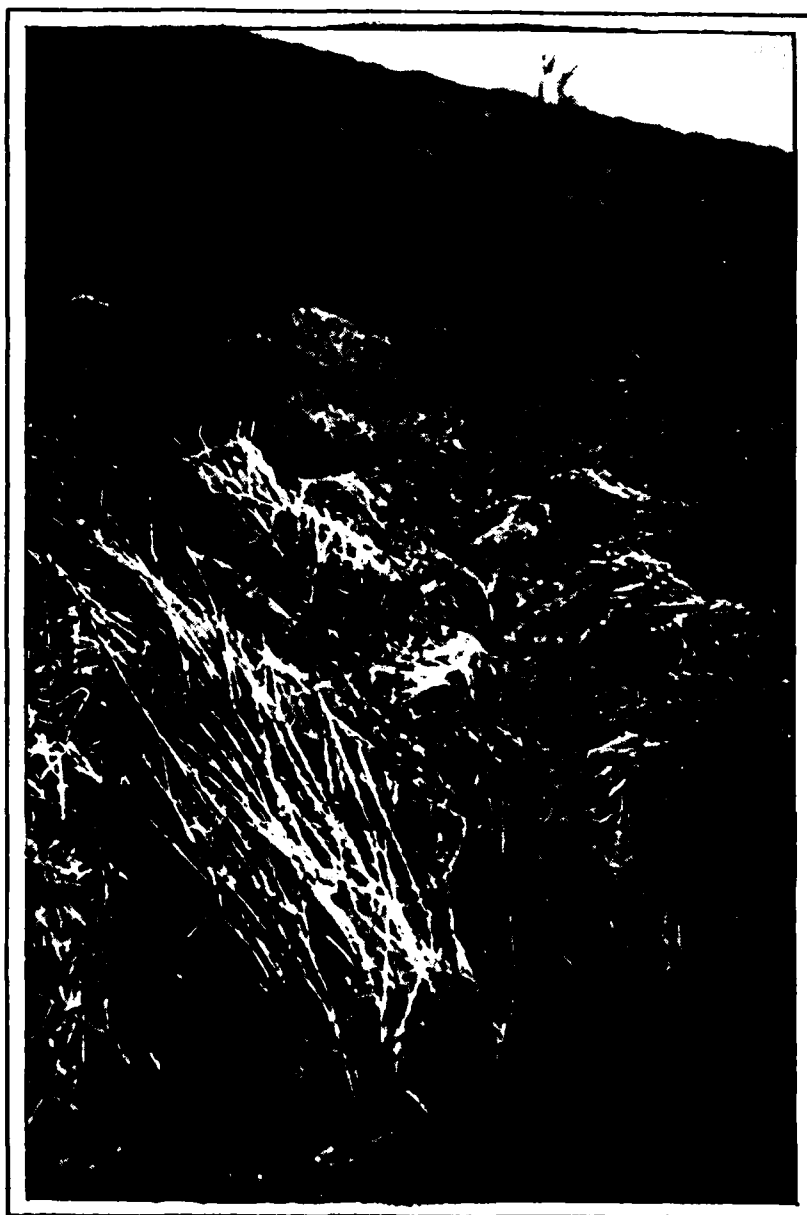
OVERALL VIEW OF DOWNSTREAM SLOPE.

PHOTOGRAPH NO. 8



DOWNSTREAM JUNCTION OF
EMBANKMENT AND RIGHT
ABUTMENT. FIVE INCH
EROSION SCARP IS UNDER
VEGETATION.

PHOTOGRAPH NO. 9



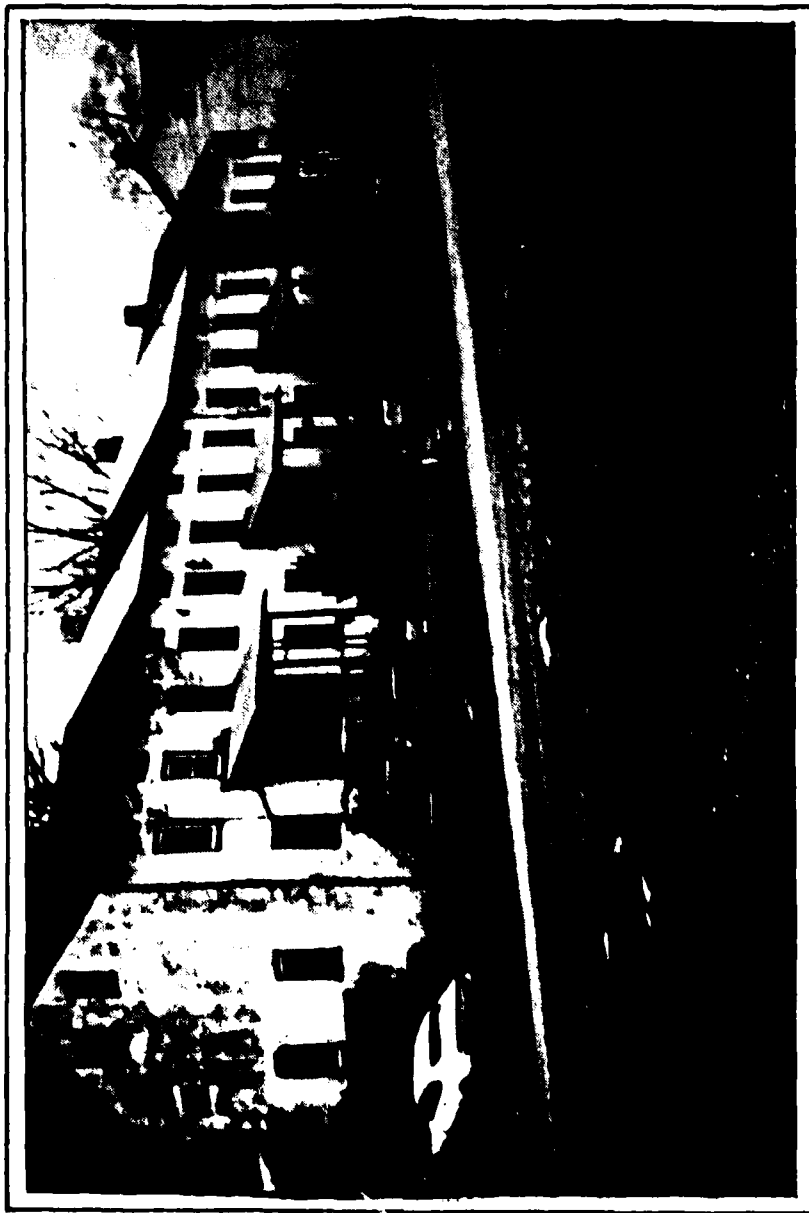
DOWNSTREAM JUNCTION OF
EMBANKMENT AND LEFT
ABUTMENT. PATH WORN
THROUGH VEGETATION.

PHOTOGRAPH NO. 10



MINOR EROSION BETWEEN IMPACT BASIN AND
EMBANKMENT.

PHOTOGRAPH NO. 11



DOWNSTREAM HAZARD CENTER AT BONDSVILLE.

PHOTOGRAPH NO. 12

APPENDIX

D

Beaver Creek Dam
(SCS PA 433)
CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

Sheet 1 of 6

DRAINAGE AREA CHARACTERISTICS: Predominantly open /farm land, less than 1% residential.
ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): Dry, pond drain at 477.5 feet.
ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 510.8 feet (1464 Acre-Feet)
ELEVATION MAXIMUM DESIGN POOL: 506.6 feet design high water.
ELEVATION TOP DAM: 510.8 feet.

EMERGENCY SPILLWAY

- a. Elevation 504.8 feet.
- b. Type Trapezoidal vegetated channel.
- c. Width 225 feet.
- d. Length 500 feet.
- e. Location Spillover left abutment.
- f. Number and Type of Gates None.

PRINCIPAL SPILLWAY

- a. Type single-stage concrete drop inlet riser, 30 inch conduit and impact basin.
- b. Location Dam station 16+50, maximum section.
- c. Entrance inverts 486.6 feet.
- d. Exit inverts 474. 5
- e. Emergency drawdown facilities 24 inch pond drain orifice at 477.5.

HYDROMETEOROLOGICAL GAGES:

- a. Type None within watershed.
- b. Location N/A
- c. Records N/A

MAXIMUM NON-DAMAGING DISCHARGE: Not determined.

Beaver Creek Dam
(SCS PA 433)
HYDROLOGIC AND HYDRAULIC
BASE DATA

Sheet 2 of 6

DRAINAGE AREA: (1) 3.1 square miles.

PROBABLE MAXIMUM PRECIPITATION (PMP)
USED IN DESIGN: (1) 26 inches in 6 hours.

HYDROGRAPH PARAMETERS: (1)
Runoff Curve Number 72
Time of Concentration 2.5 hours

SPILLWAY CAPACITY AT MAXIMUM
WATER LEVEL: (1) 9409 cfs.

(1) From SCS Design Folder

BY MEB DATE 7/3/80

SUBJECT

SHEET 3 OF 6

CHKD. BY _____ DATE _____

Beaver Creek Dam

JOB No. _____

Hydrology / Hydraulics

Classification (Ref. Recommended Guidelines for Safety Inspection of Dams)

1. The hazard potential is rated as "High" as there would be excessive economic loss and loss of life in the event of failure.
2. The size classification is "Intermediate" based on its 1,464 Ac.-Ft. total storage capacity.
3. The spillway design flood, based on size and hazard classification, is the Probable Maximum Flood (PMF).

Hydrologic and Hydraulic Analysis

The H & H design folder was available for review. The PMF (no freboard) hydrograph was determined according to procedures in the SCS National Engineering Handbook, Section 4. Hydrograph calculations and flood routing were performed by the SCS computer program, TR-20. Portions of the original design folder are included in this Appendix.

Original design parameters were checked against current information and/or criteria. Drainage area shown on sheet 2 was verified from USGS map.

Runoff curve number calculations, sheet 4, represent a 25% developed watershed. Current development is estimated to be about 1%.

Based on review of the design folder, the original PMF flood routing is judged adequate. Therefore, the spillways for this structure are considered "Adequate".

PLAINING AREA (A) = 2016 AC' = 3.1 SQ MI

REFERENCE: NEA-SECTION 4

1 SOIL GROUP	2 COMPLEX (LAND USE)	3 CURVE NO.	4 ACRES (A)	5 (3) x (4)
B	CROPLAND	79	300	23,700
B	SMALL GRAIN	73	300	21,900
B	GRASSLAND	61	670	40,870
B	WOODLAND	60	200	12,000
C	WOODLAND	73	50	3,650
B	SUBURBAN & OTHER	85	49½	42,160
SUM			20.16	144,280

Ref. SCS Design
Folder

$$\text{WEIGHTED CURVE NO II} = \frac{-(5)}{(4)} = \underline{71.6} \text{ use } \underline{72}$$

ADJUSTED CURVE NO. 1 = _____

[illegible]

SEE "ITEM - SECTION 4"

E. S. DESIGN AND FREEBOARD ROUTINGS.

BRANDYVINE CREEK WATERSHED PA 433

MAR 1972 JDG

CURVE NO. 72. TC 2.50 STORM DURATION 6.00.

EMER. SPW. RAINFALL 10.75 FREEBOARD RAINFALL 26.00
CASE NO. 2. DRAINAGE AREA 3.10 EMER. SPW. CREST 504.8~~861 195. 11 500 602 210 12 500 803 225. 13 500.~~

ELEVATION	STORAGE	CFS	CFS	CFS
486.61	43.	0.	0.	0.
488.60	71.	50.	50.	56.
492.79	184.	72.	72.	72.
496.98	359.	84.	84.	84.
500.12	505.	93.	93.	93.
503.26	718.	100.	100.	100.
504.80	843.	104.	104.	104.
505.30	884.	200.	216.	224.
505.80	925.	451.	478.	504.
506.30	966.	798.	851.	904.
506.40	974.	910.	972.	1034.
507.80	1128.	2490.	2673.	2856.
509.30	1294.	4969.	5343.	5716.
510.59	1436.	7722.	8307.	8892.
510.80	1464.	8170.	8790.	9409.
512.30	1658.	12015.	12930.	13845.
513.80	1852.	16426.	17680.	18934.
514.59	1955.	19095.	20554.	22013.

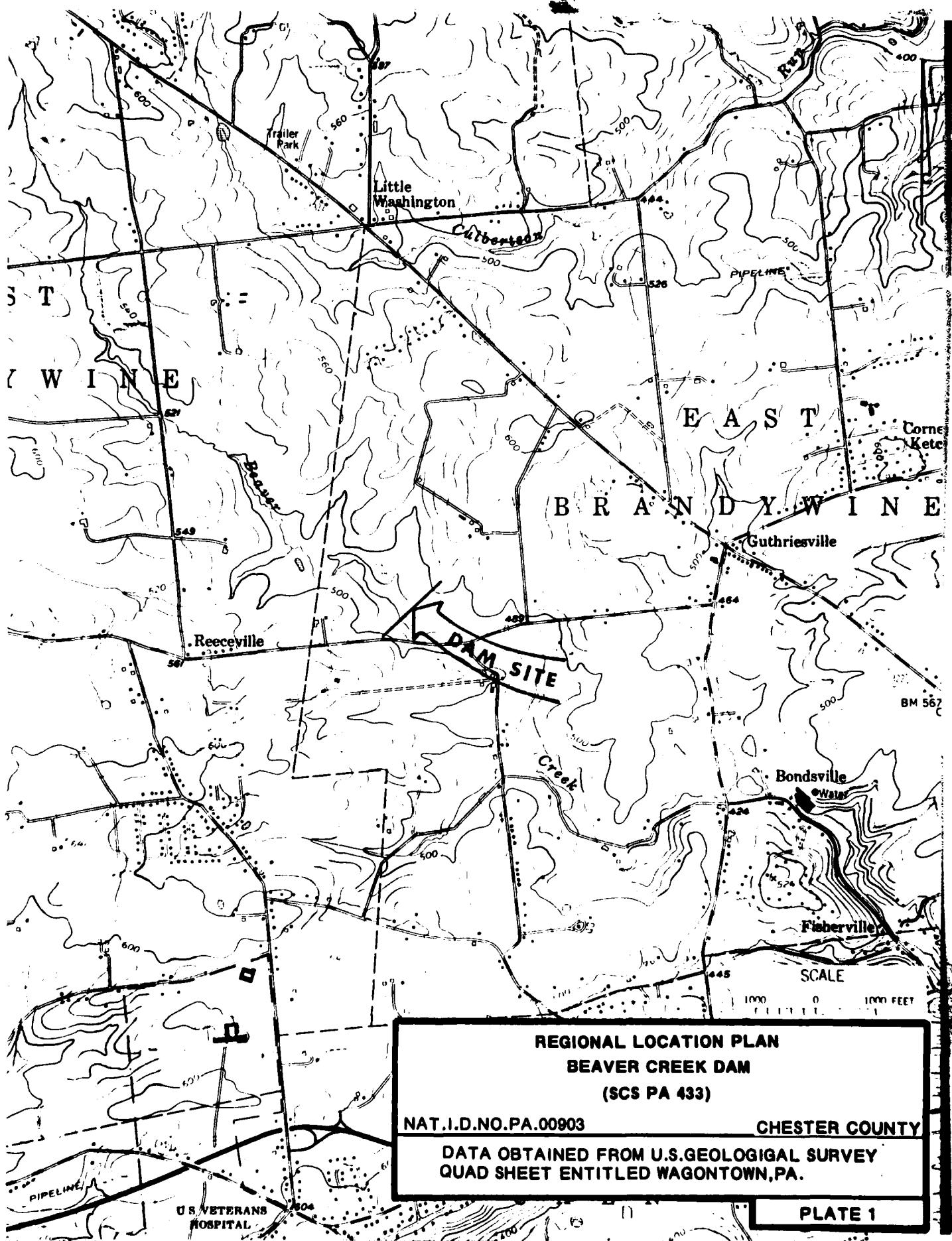
Ref. SCS Design
Folder

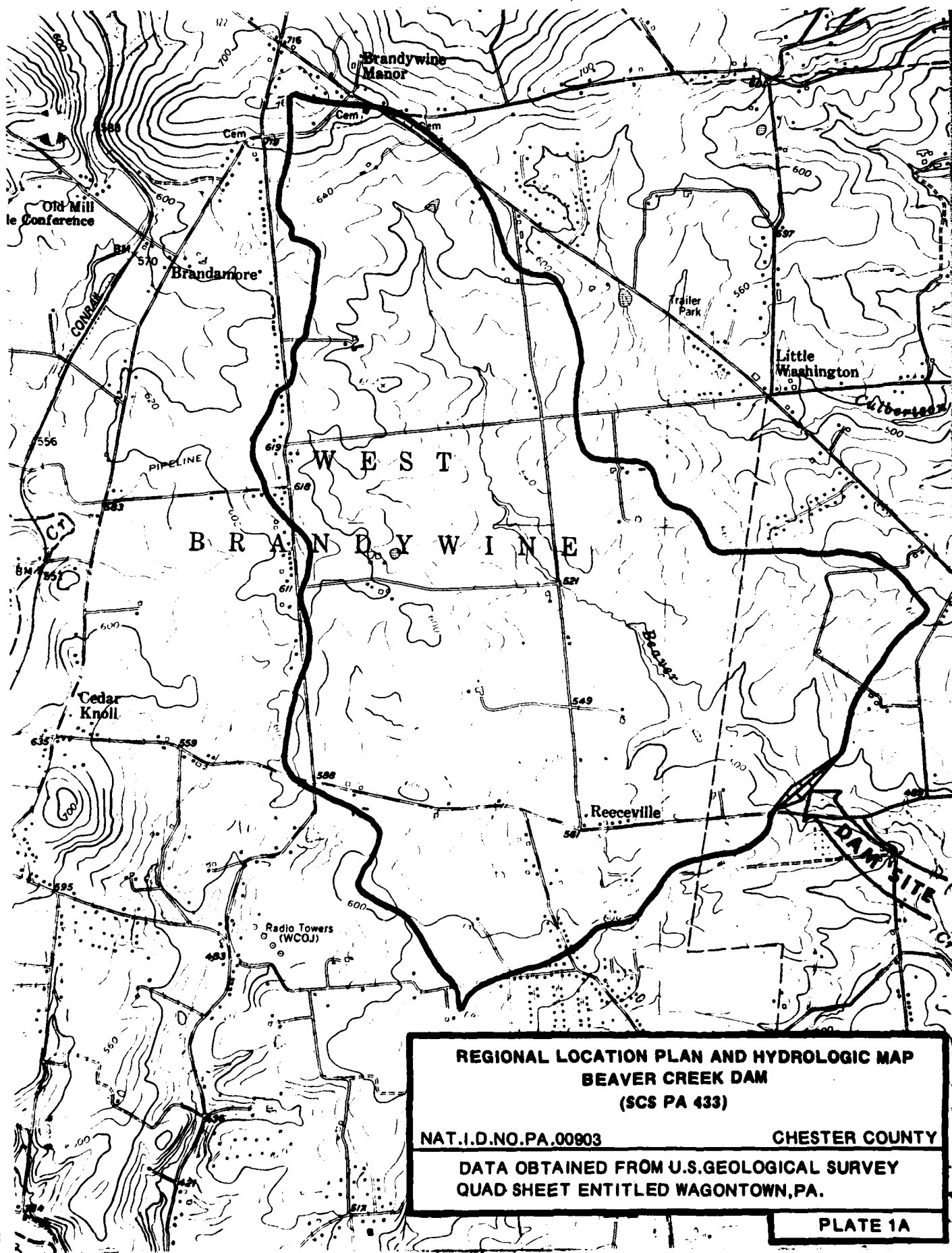
FREEBOARD ROUTING.					
BRANDYME CREEK WATERSHED, PA 433					
MAR 1972 JCG					
BO = 275 L = 500.					
TIME	INFLCW	AVE IN	OUTFLOW	ELEV.	
0.25	0.	0.	0.	486.60	
0.50	2.	1.	0.	486.61	
0.75	10.	6.	0.	486.62	
1.00	46.	26.	1.	486.64	
1.25	101.	73.	4.	486.76	
1.50	269.	185.	11.	487.02	
1.75	504.	386.	27.	487.56	
2.00	1028.	766.	56.	488.61	
2.25	1861.	1445.	60.	489.67	
2.50	3105.	2483.	67.	491.52	
2.75	4866.	3986.	75.	493.91	
3.00	6835.	5851.	84.	496.76	
3.25	8800.	7817.	93.	500.17	
3.50	10477.	9638.	100.	503.09	
3.75	11435.	10956.	519.	505.81	
4.00	11761.	11598.	2897.	507.82	
4.25	11619.	11687.	5559.	509.21	
4.50	10999.	11306.	7675.	510.09	
4.75	10290.	10645.	8786.	510.54	
5.00	9477.	9884.	9160.	510.69	
5.25	8709.	9093.	9138.	510.68	
5.50	8000.	8355.	8875.	510.58	
5.75	7373.	7687.	8432.	510.46	
6.00	6778.	7075.	7924.	510.19	
6.25	6241.	6509.	7395.	509.98	
6.50	5697.	5969.	6861.	509.76	
6.75	5134.	5415.	6319.	509.54	
7.00	4540.	4832.	5764.	509.31	
7.25	3922.	4231.	5291.	509.07	
7.50	3319.	3620.	4785.	508.81	
7.75	2734.	3027.	4252.	508.53	
8.00	2248.	2491.	3719.	508.25	
8.25	1819.	2034.	3209.	507.98	
8.50	1467.	1643.	2769.	507.73	
8.75	1193.	1330.	2457.	507.49	
9.00	950.	1072.	2156.	507.26	
9.25	776.	863.	1875.	507.04	
9.50	616.	696.	1619.	506.84	
9.75	489.	552.	1388.	506.67	
10.00	382.	436.	1181.	506.51	
10.25	292.	337.	987.	506.36	
10.50	228.	260.	824.	506.20	
10.75	172.	200.	709.	506.05	
11.00	135.	154.	607.	505.92	
11.25	103.	119.	518.	505.81	
11.50	79.	91.	457.	505.71	
11.75	60.	70.	406.	505.62	
12.00	44.	52.	359.	505.54	
12.25	34.	39.	317.	505.46	
12.50	24.	29.	279.	505.39	
12.75	17.	21.	244.	505.33	
13.00	11.	14.	220.	505.28	
13.25	6.	9.	207.	505.22	

Ref. SCS Design
Folder

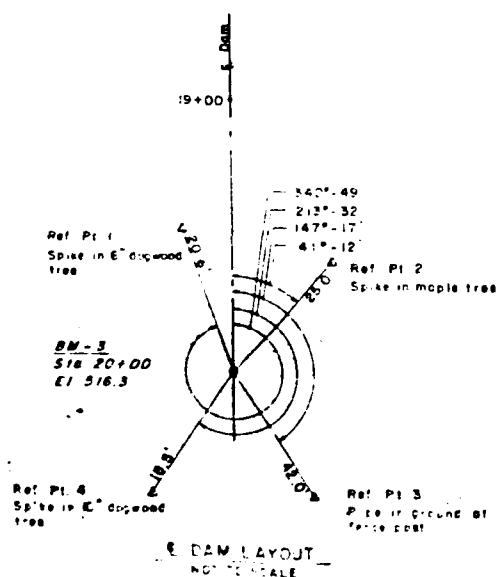
APPENDIX

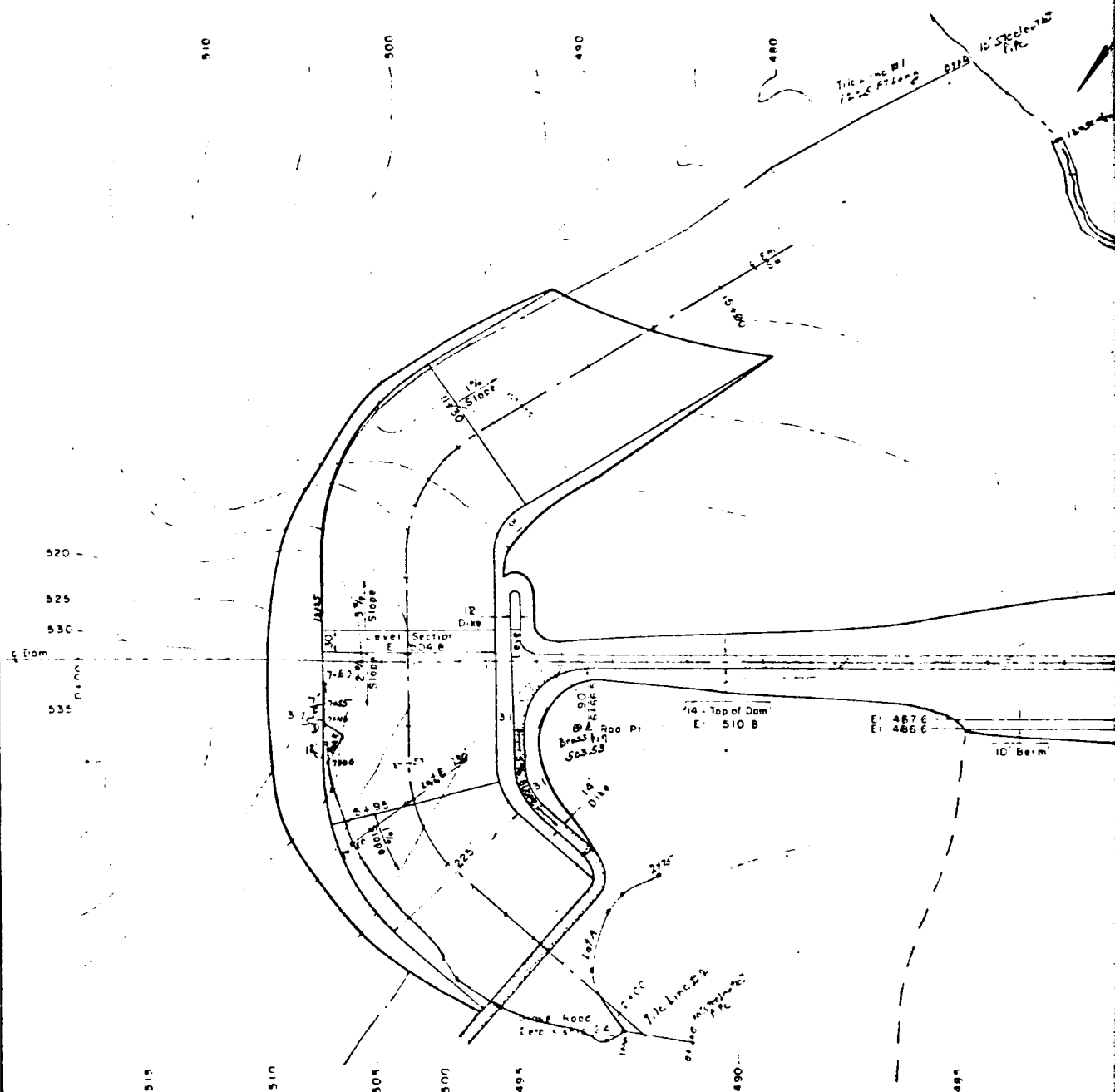
E

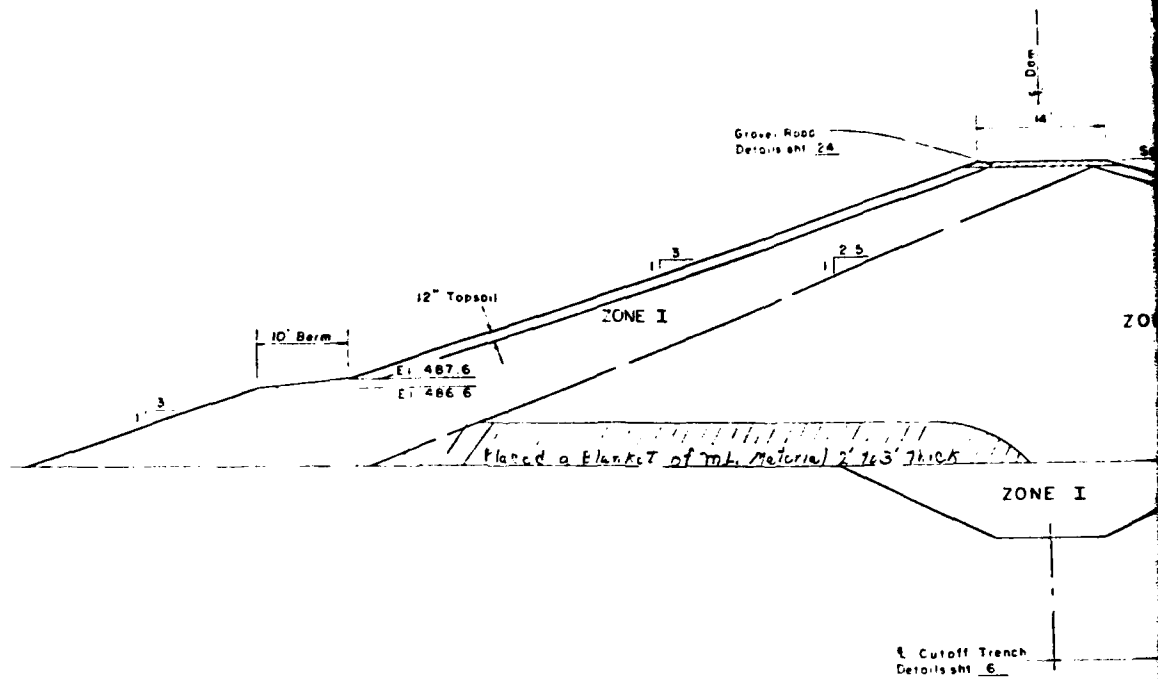




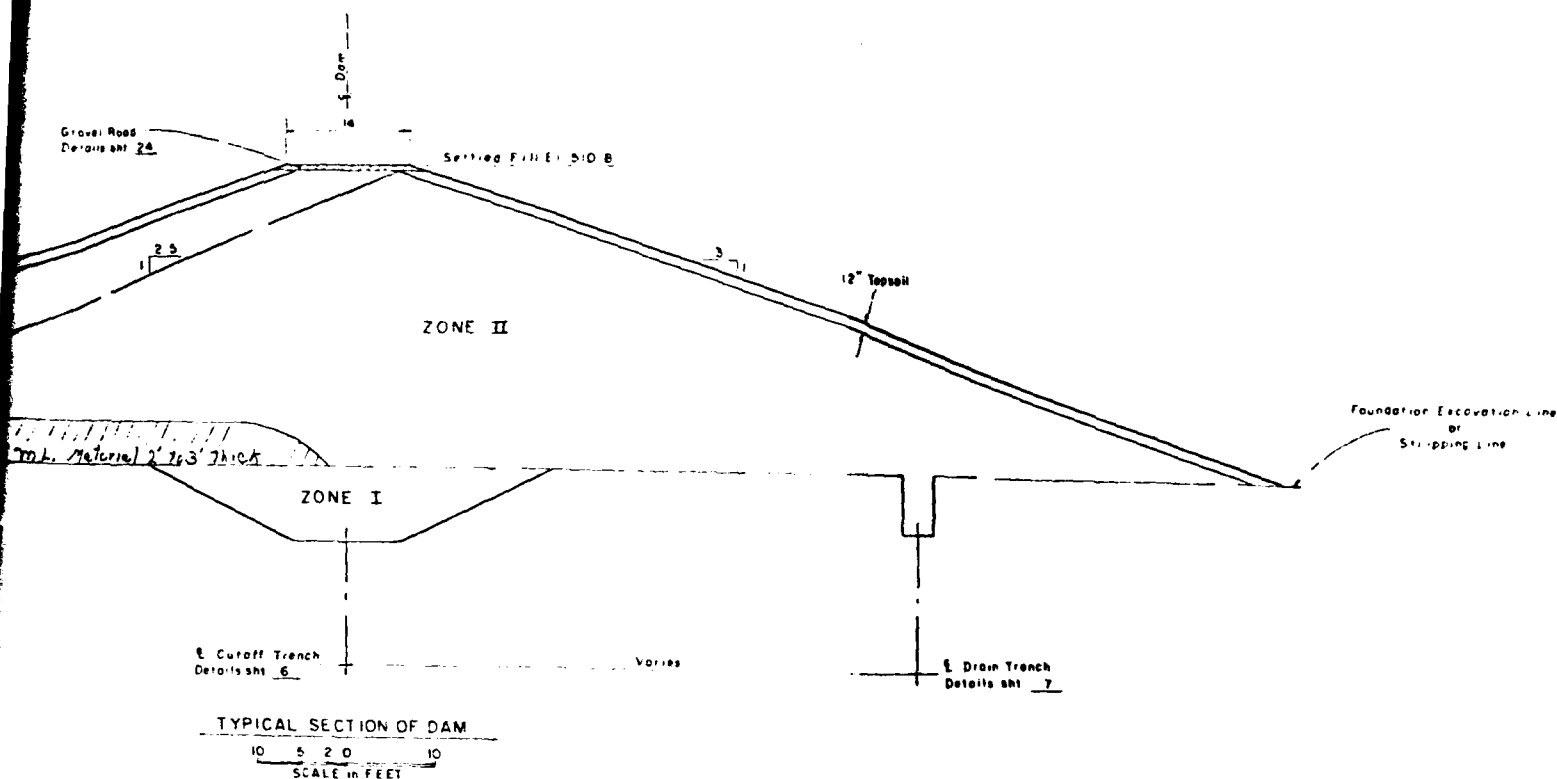
1 - 7 Stream Crossing







TYPICAL SECTION OF D
 10 5 2 0 10
 SCALE IN FEET



CONSTRUCTION NOTES

- 1 Constructed slopes are 2:1 upstream and downstream
- 2 For constructed fill elevations see sheet 6

PLACEMENT	MATERIAL	MAX ROCK SIZE ¹	MAX LIFT ¹	REQ'D WATER CONTENT ²	COMPACTION ³	
					CLASS	DEFINITION
Zone I	Material as represented by TP-215, depth 1'-3'; TP-106, depth 0'-3'; TP-116, depth 0'-2.5'; classified as CL, ML & ML respectively.	6"	9"	Optimum + 2%	A	95% Max density by ASTM D-698, Method 'A'
Zone II	Material as represented by TP-215, depth 3'-7'; TP-105, depth 3.5'-6.5'; classified as SM	6"	9"	Optimum - 2% to + 2%	A	95% Max density by ASTM D-698, Method 'A'

- ¹ Maximum permissible lift thickness before compaction
- ² Water content of fill matrix at time of compaction. Variation from water content shown may be approved by the Engineer.
- ³ For typical compaction curves see sheet 33.
- ⁴ Zone I material is to be used to backfill foundation excavation
- ⁵ For hand compacted backfill, the max. rock size and lift thickness shall not exceed one half of the size and thickness shown.

AS BUILT

BRANDYWINE CREEK WATERSHED
FLOODWATER RETARDING DAM PA-433
CHESTER COUNTY, PENNSYLVANIA

FILL PLACEMENT

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

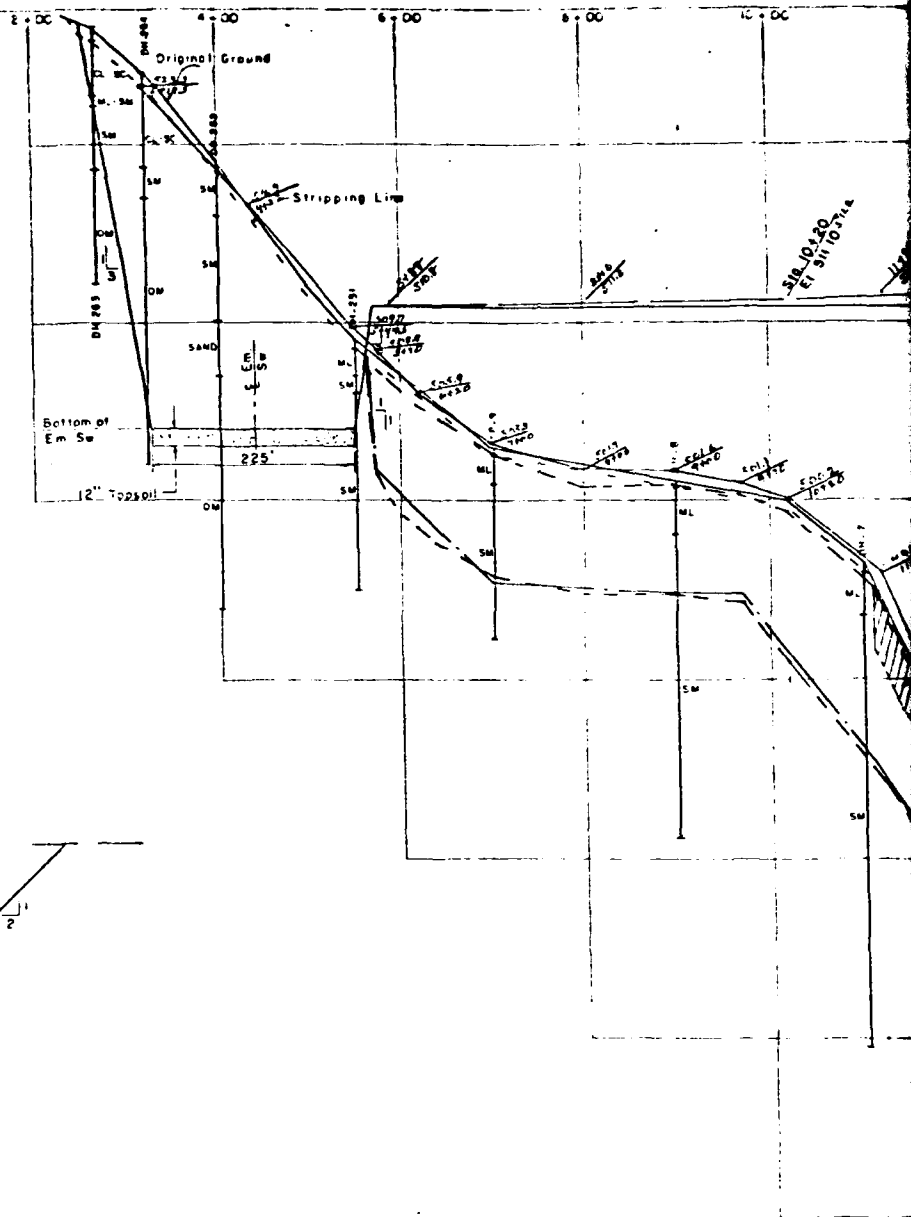
CRISE

10-72

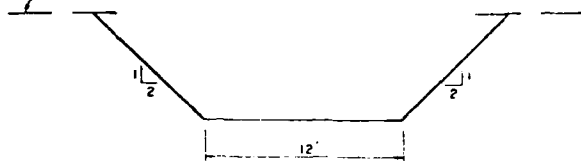
PLATE 4

PA-433-P

PA-433-P



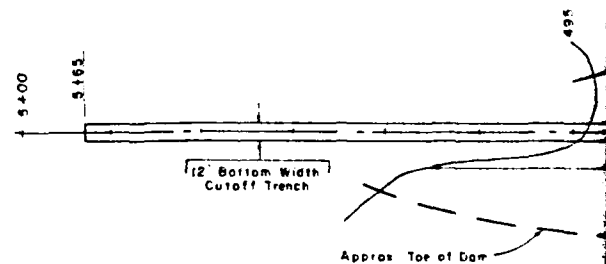
Stripping Line or
Bottom of Foundation Excavation

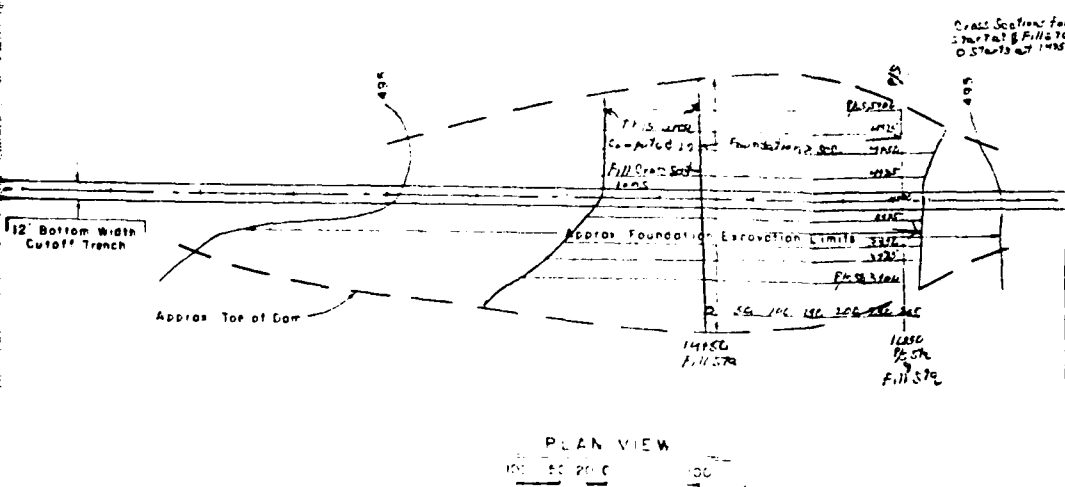
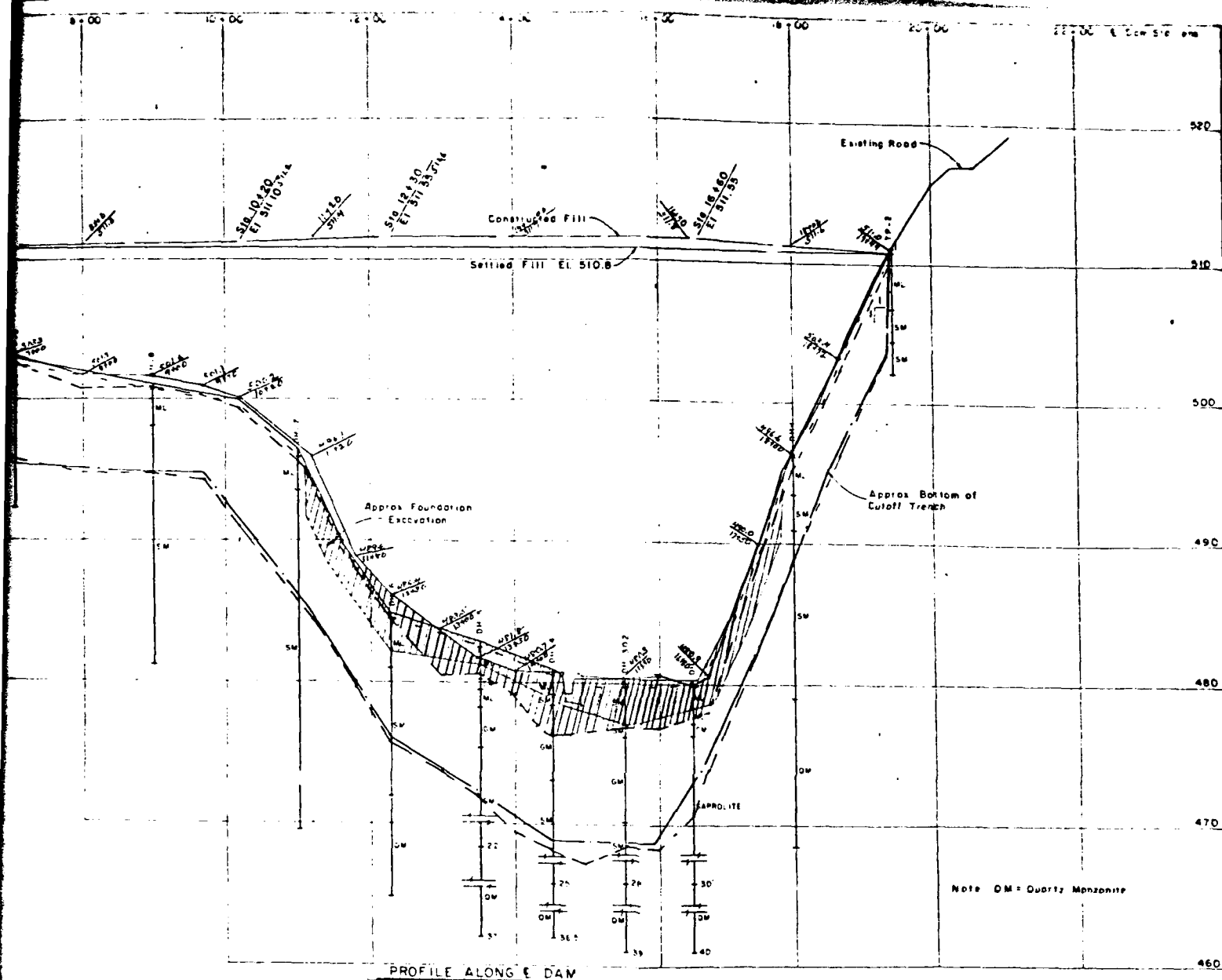


TYPICAL SECTION

CONSTRUCTION NOTES

1. Dam + Cutoff Trench
2. For logs of test holes see shts. 26 thru 32.





BRANDYWINE CREEK WATERSHED
FLOODWATER RETARDING DAM PA-433
CHESTER COUNTY, PENNSYLVANIA

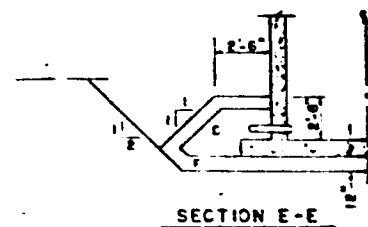
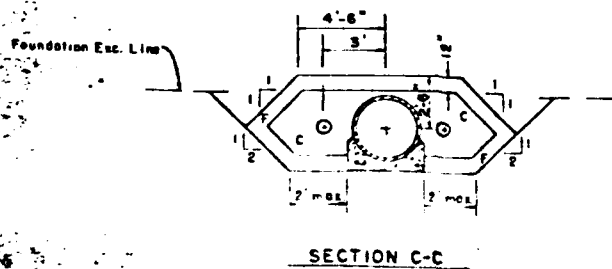
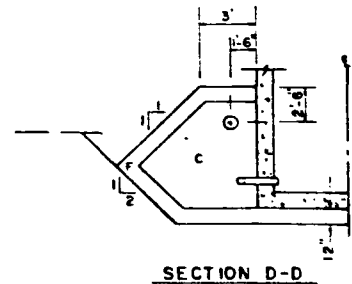
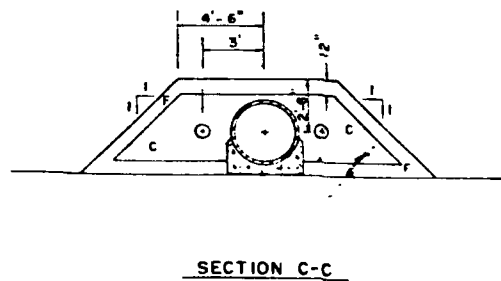
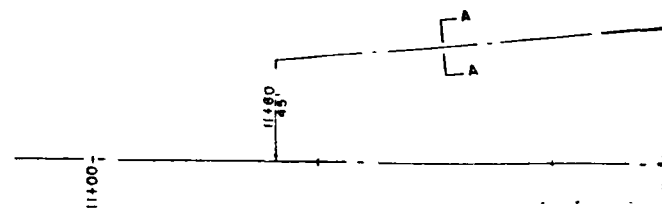
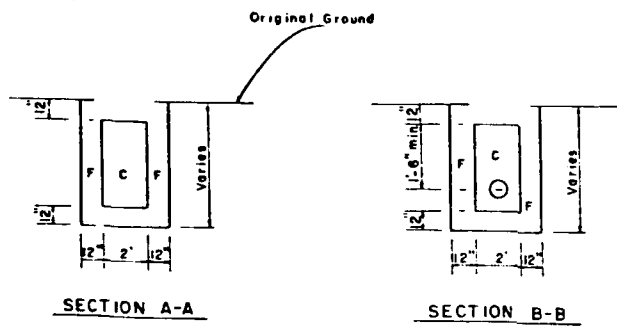
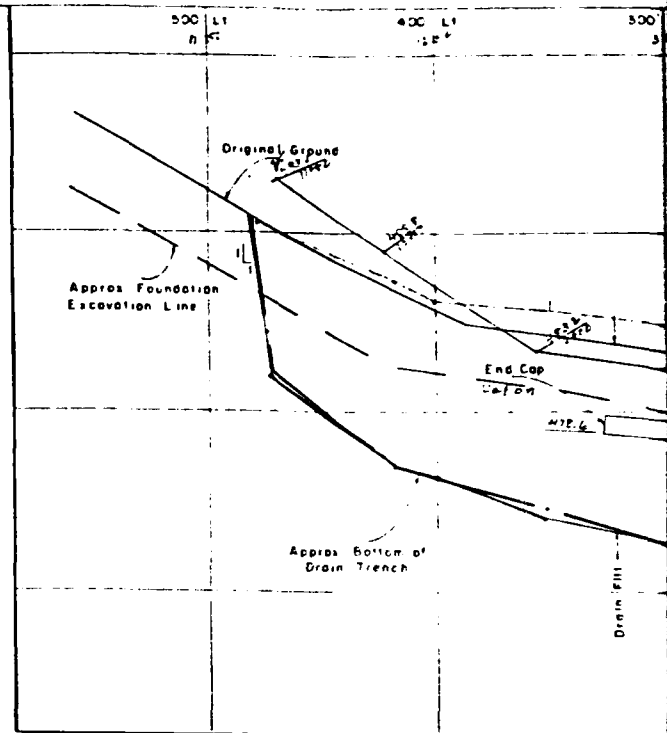
CUTOFF TRENCH

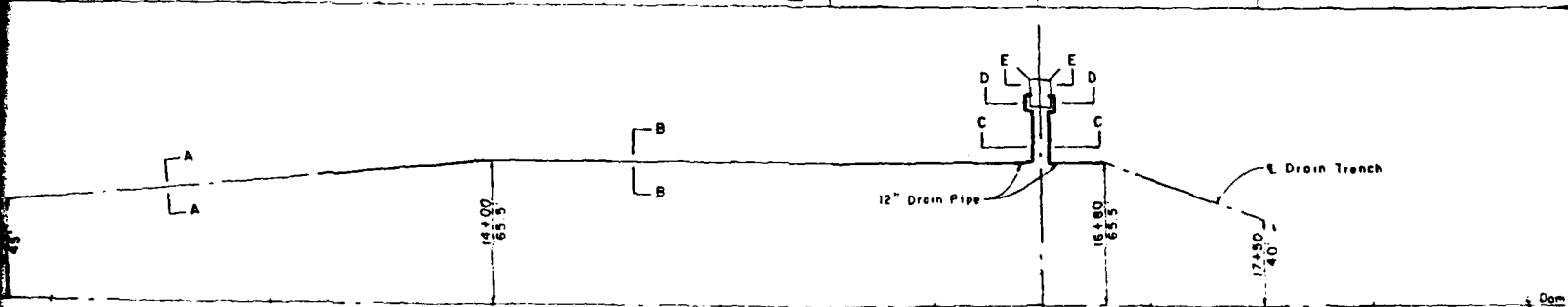
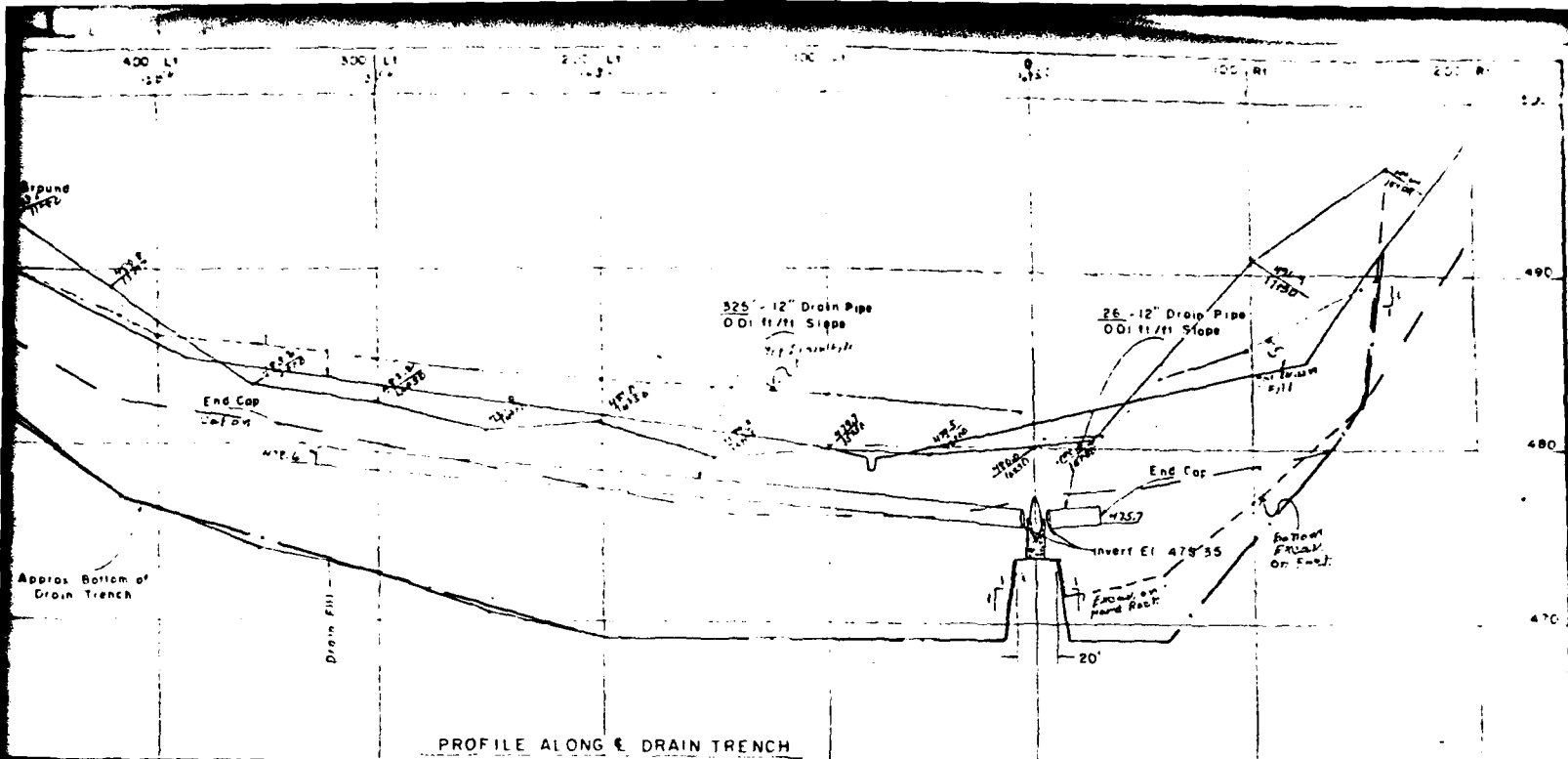
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

CRISE 5-72

PA-433-P

PLATE 5





PLAN VIEW
SCALE IN FEET

"COARSE"		GRADATION LIMITS FOR DRAIN FILL		"FINE"	
SEIVE NO.	% PASSING (Based on Dry Weight)	SEIVE NO.	% PASSING (Based on Dry Weight)	SEIVE NO.	% PASSING (Based on Dry Weight)
1/2"	100	3/8"	100	3/8"	100
3/8"	75 - 100	no 4	90 - 100	no 4	90 - 100
no 4	10 - 30	no 8	70 - 92	no 8	70 - 92
no 8	0 - 10	no 16	50 - 80	no 16	50 - 80
no 200	< 3	no 30	30 - 65	no 30	30 - 65
		no 50	10 - 30	no 50	10 - 30
		no 100	1 - 8	no 100	1 - 8
		no 200	< 3	no 200	< 3

CONSTRUCTION NOTE

All drain pipe shall be 12" dia, Class I or II, Shape 1, Coating A, 16 Gage, Perforated, Spec 551

C = Coarse Drain Fill
F = Fine Drain Fill

AS BUILT PLANS

QUANTITY SUMMARY

- 19 - 20' Sections
 - 2 - 10' Sections
 - 2 - 7' Sections
 - 2 - 1' - 8" Sections
 - 2 - 1' - 6" Sections
 - 1 - 5' Section
 - 1 - 6' Section
 - 8 - 90° Elbows (11-4" x 11-4")
 - 2 - End Caps
 - 2 - Small Animal Guards (shl 24)
 - 452 - 8" - Total
- Note: Lengths given may be varied as approved by the Engineer

BRANDYWINE CREEK WATERSHED

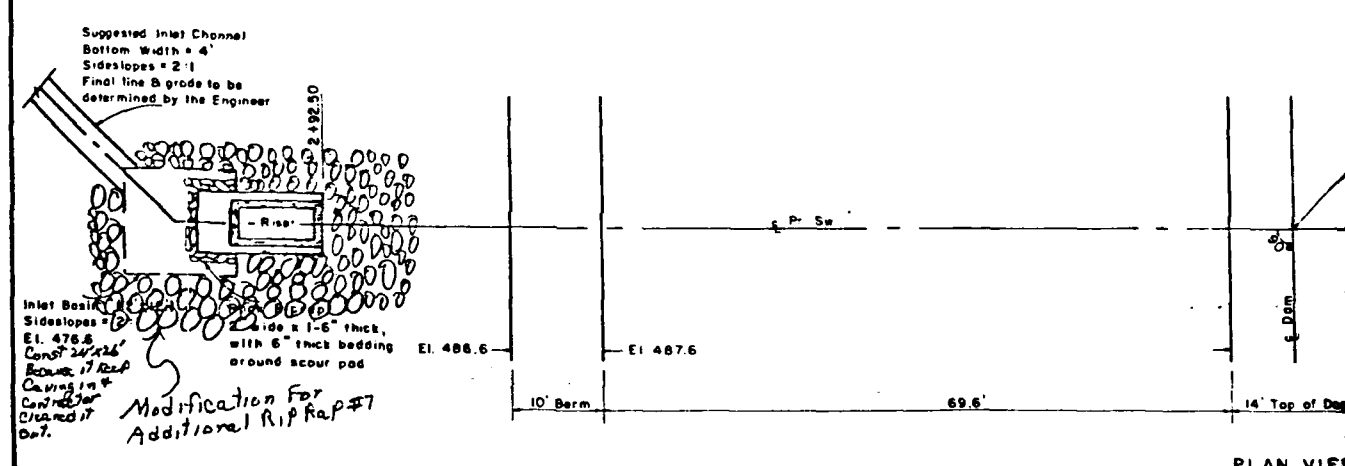
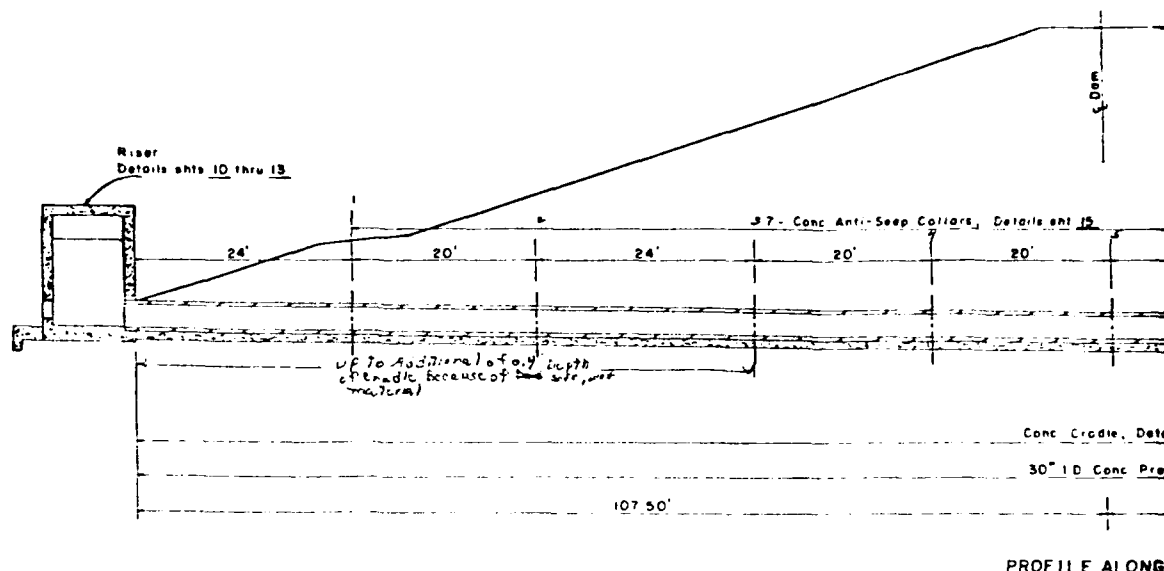
FLOODWATER RETARDING DAM PA-433
CHESTER COUNTY, PENNSYLVANIA

DRAINAGE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLATE 6

PA-433-P



AS BUILT
30" I.D. PIPE JOINT DATA

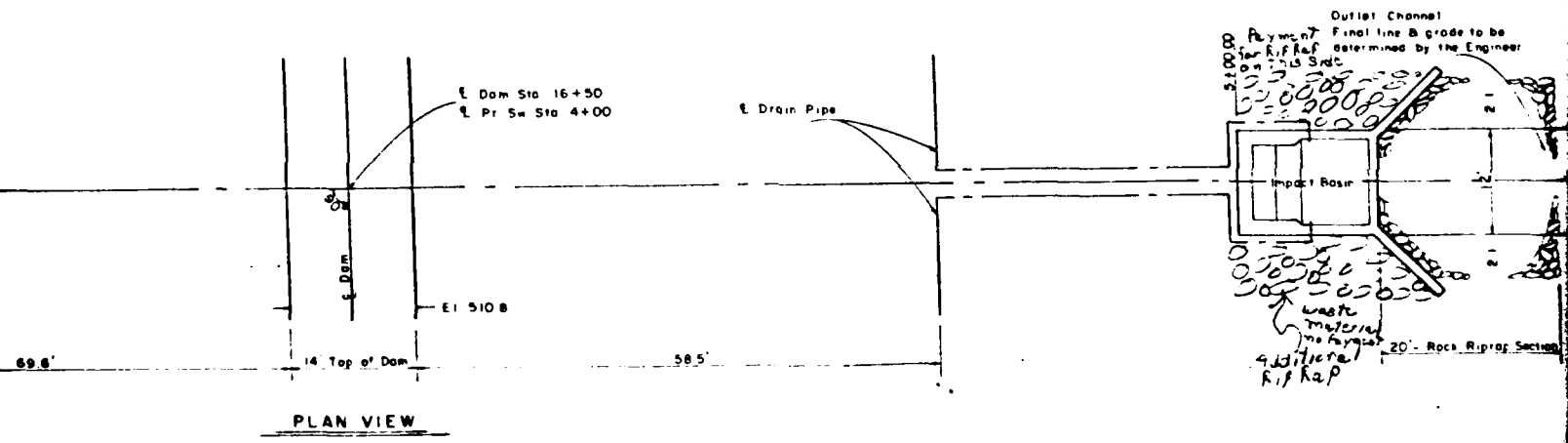
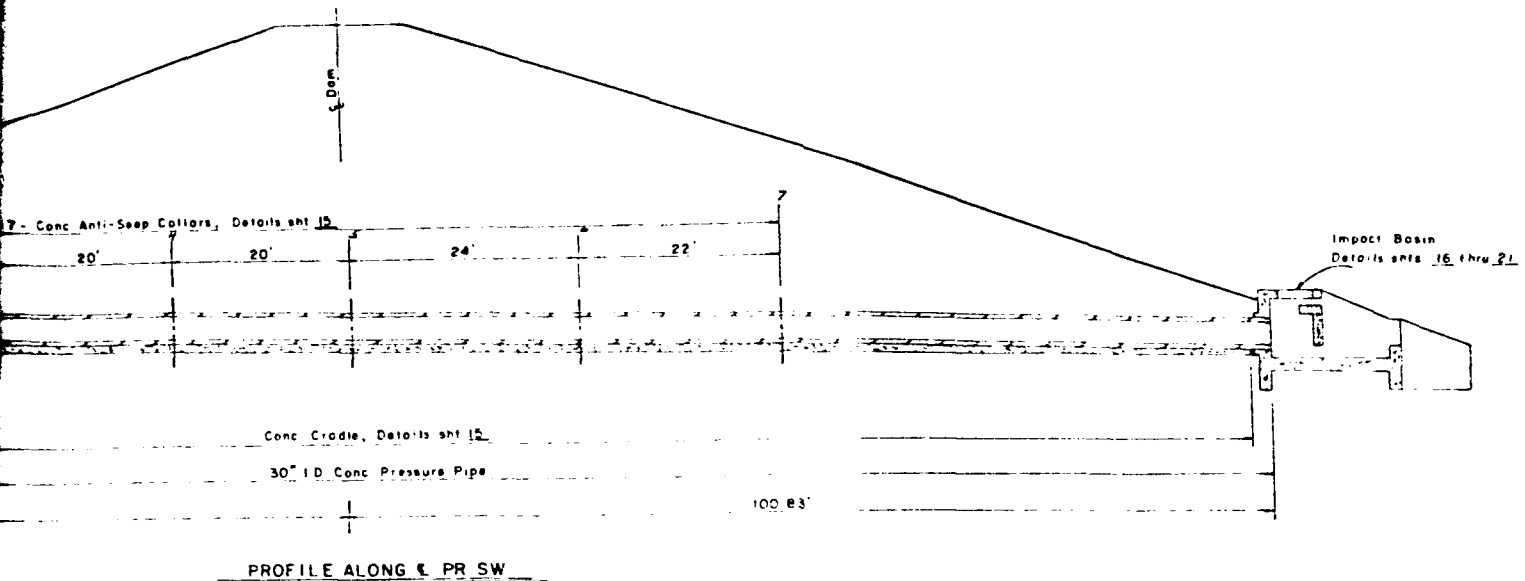
JOINT	DIST. FROM RISER WALL	INVERT EL.
1-2	20.33	476.45
2-3	20.33	476.45
3-4	20.33	476.45
4-5	20.33	476.45
5-6	20.33	476.45
6-7	20.33	476.45
7-8	20.33	476.45
8-9	20.33	476.45
9-10	20.33	476.45
10-11	20.33	476.45
11-12	20.33	476.45
12-13	20.33	476.45
13-14	20.33	476.45
14-15	20.33	476.45
15-16	20.33	476.45
16-17	20.33	476.45
17-18	20.33	476.45
18-19	20.33	476.45
19-20	20.33	476.45
20-21	20.33	476.45
21-22	20.33	476.45
22-23	20.33	476.45
23-24	20.33	476.45
24-25	20.33	476.45
25-26	20.33	476.45
26-27	20.33	476.45
27-28	20.33	476.45
28-29	20.33	476.45
29-30	20.33	476.45
30-31	20.33	476.45
31-32	20.33	476.45
32-33	20.33	476.45
33-34	20.33	476.45
34-35	20.33	476.45
35-36	20.33	476.45
36-37	20.33	476.45
37-38	20.33	476.45
38-39	20.33	476.45
39-40	20.33	476.45
40-41	20.33	476.45
41-42	20.33	476.45
42-43	20.33	476.45
43-44	20.33	476.45
44-45	20.33	476.45
45-46	20.33	476.45
46-47	20.33	476.45
47-48	20.33	476.45
48-49	20.33	476.45
49-50	20.33	476.45
50-51	20.33	476.45
51-52	20.33	476.45
52-53	20.33	476.45
53-54	20.33	476.45
54-55	20.33	476.45
55-56	20.33	476.45
56-57	20.33	476.45
57-58	20.33	476.45
58-59	20.33	476.45
59-60	20.33	476.45
60-61	20.33	476.45
61-62	20.33	476.45
62-63	20.33	476.45
63-64	20.33	476.45
64-65	20.33	476.45
65-66	20.33	476.45
66-67	20.33	476.45
67-68	20.33	476.45
68-69	20.33	476.45
69-70	20.33	476.45
70-71	20.33	476.45
71-72	20.33	476.45
72-73	20.33	476.45
73-74	20.33	476.45
74-75	20.33	476.45
75-76	20.33	476.45
76-77	20.33	476.45
77-78	20.33	476.45
78-79	20.33	476.45
79-80	20.33	476.45
80-81	20.33	476.45
81-82	20.33	476.45
82-83	20.33	476.45
83-84	20.33	476.45
84-85	20.33	476.45
85-86	20.33	476.45
86-87	20.33	476.45
87-88	20.33	476.45
88-89	20.33	476.45
89-90	20.33	476.45
90-91	20.33	476.45
91-92	20.33	476.45
92-93	20.33	476.45
93-94	20.33	476.45
94-95	20.33	476.45
95-96	20.33	476.45
96-97	20.33	476.45
97-98	20.33	476.45
98-99	20.33	476.45
99-100	20.33	476.45

AS BUILT
30" I.D. COLLAR DATA

COLLAR	DIST. FROM RISER WALL	INVERT EL.
1	20.33	476.45
2	40.66	476.45
3	60.99	476.45
4	81.32	476.45
5	101.65	476.45
6	121.98	476.45
7	142.31	476.45

30" I.D. Reinforced Concrete Pressure Pipe, Steel Cylinder Type
Spec. 541 (AWWA C-300 or C-301)

208' - Straight Sections
1 - Spigot Wall Fitting (For 10" Wall)
208' - Total



AS BUILT PLANS
 10 5 20 10
 SCALE IN FEET

Reinforced Concrete Pressure Pipe, Steel Cylinder Type
 (AWWA C-300 or C-301)

- Straight Sections
- Spigot Wall Fitting (For 10' Wall)
- Total

CONSTRUCTION NOTES

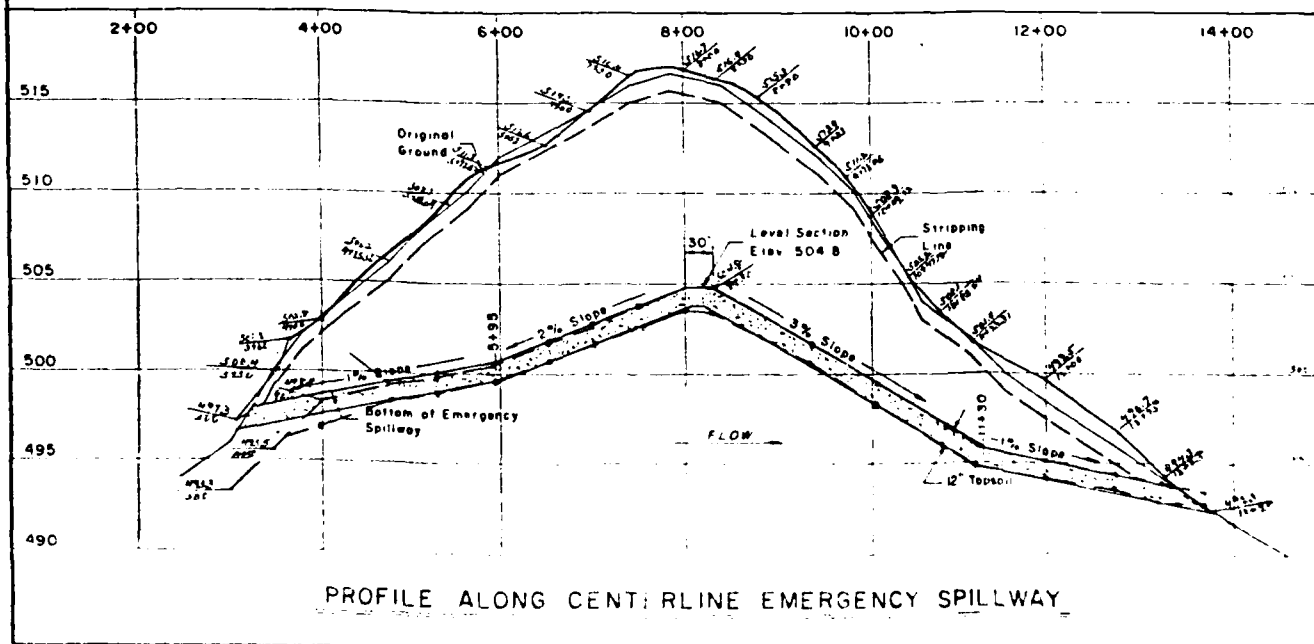
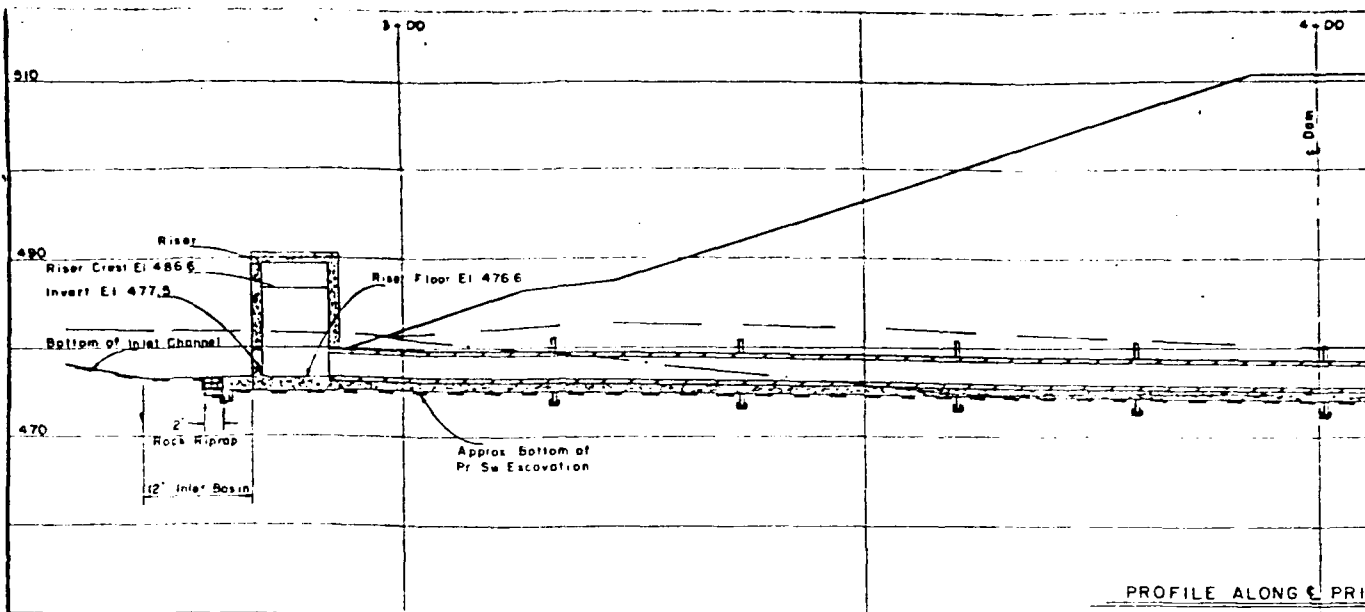
1. Outlet end of pipe to be finished so that no metal is exposed
2. Pipe layout data to be furnished by the Engineer
3. Riprap bedding shall meet fine drain fill gradation limits (sht 7)

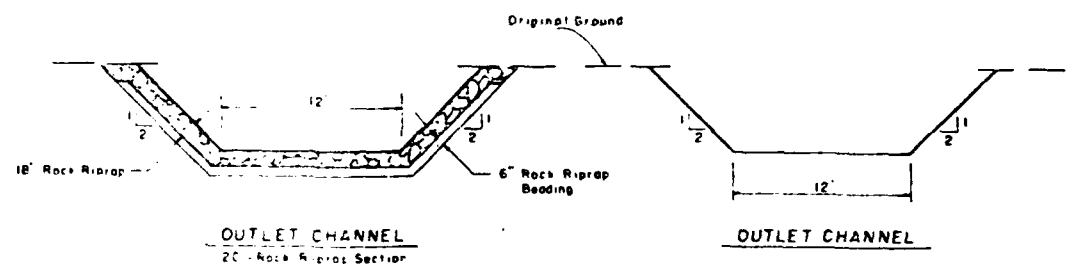
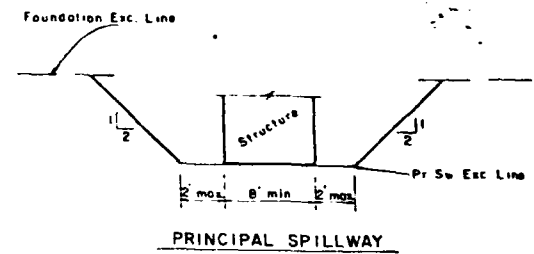
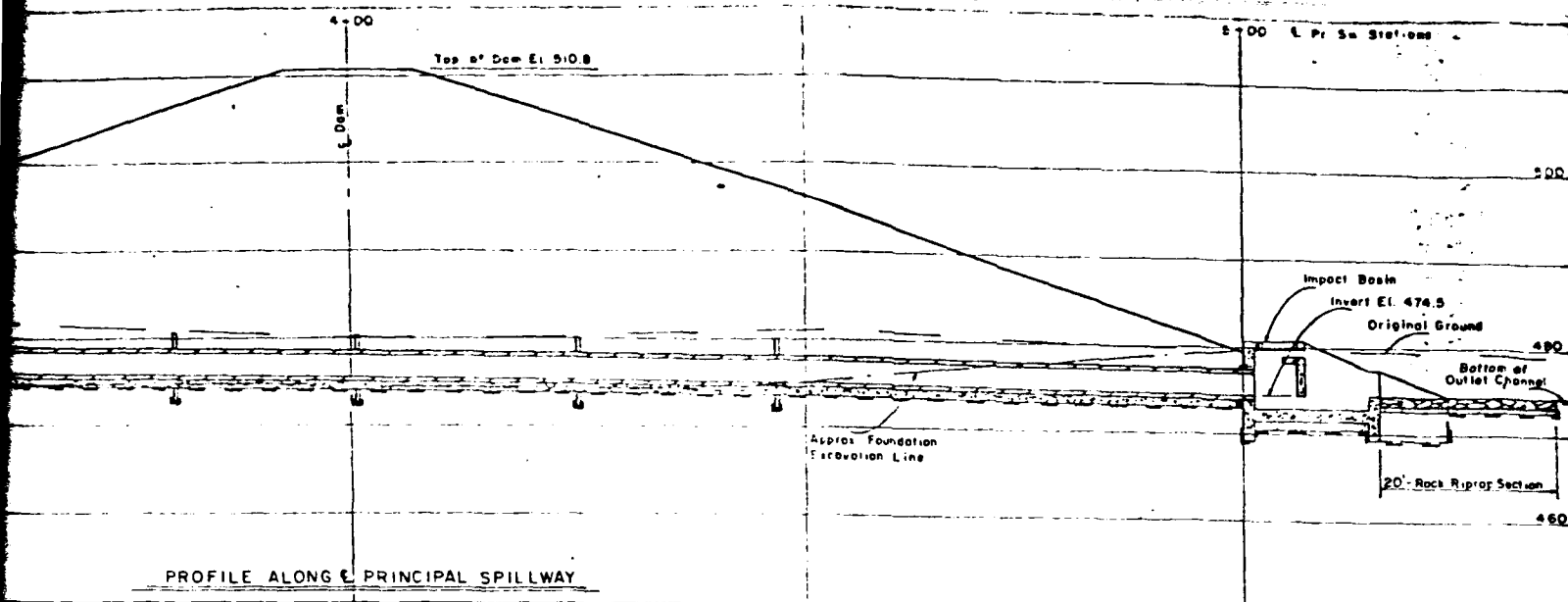
BRANDYWINE CREEK WATERSHED
FLOODWATER RETARDING DAM PA-433
CHESTER COUNTY, PENNSYLVANIA
PRINCIPAL SPILLWAY
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLATE 7

Project	PA-433	Date	1-74
Drawn by	DRIDE	Checked by	
Scale	1" = 20'	Project No.	PA-433-P

SCS ENG-311-B





PRINCIPAL SPILLWAY SECTIONS

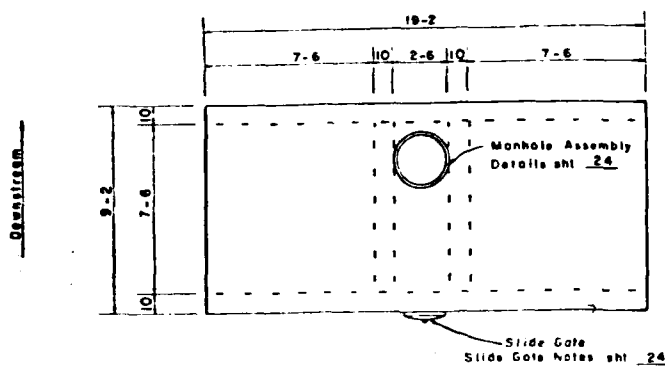
AS EXIST. PLAN

BRANDYWINE CREEK WATERSHED
 FLOODWATER RETARDING DAM PA-433
 CHESTER COUNTY, PENNSYLVANIA
 SPILLWAY EXCAVATION
 U. S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE

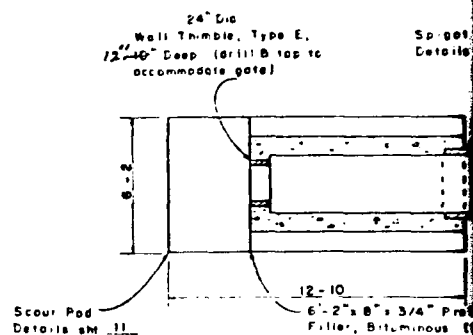
CHISE 10-72

PLATE 8

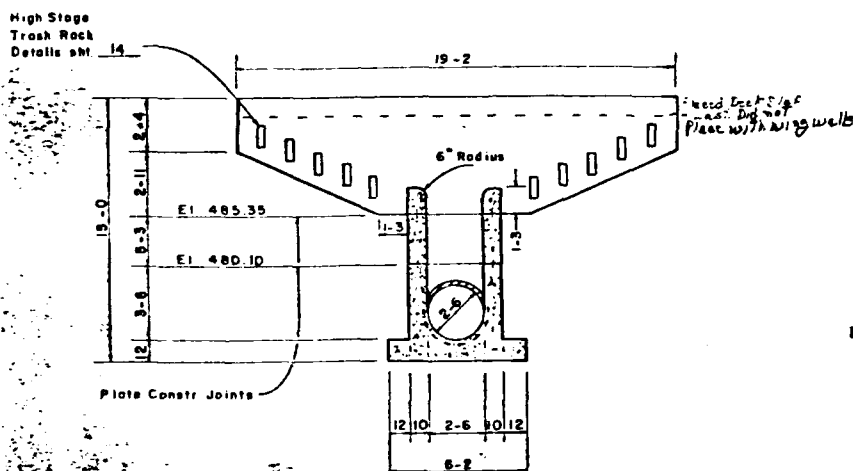
Small Station 374 33 PA-433-P



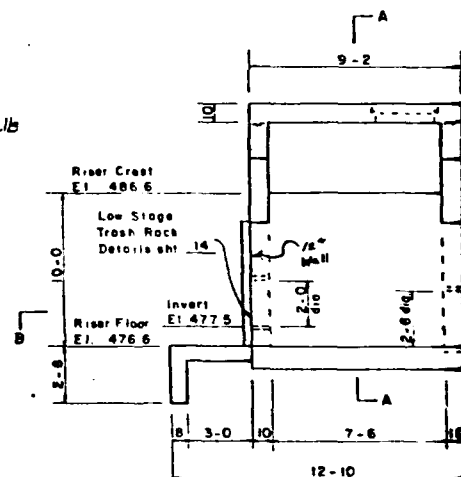
TOP - PLAN



SECTION B-B



SECTION A-A



SIDE ELEVATION

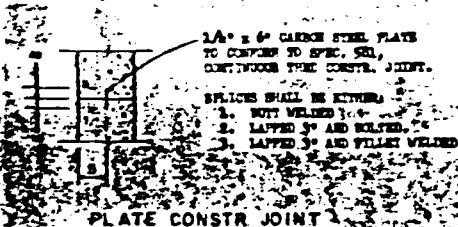
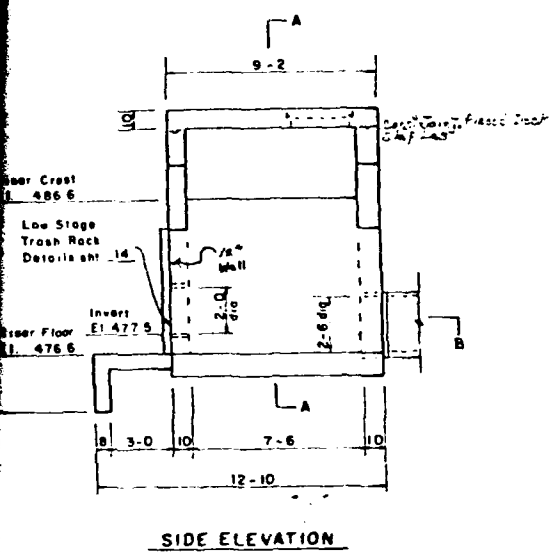
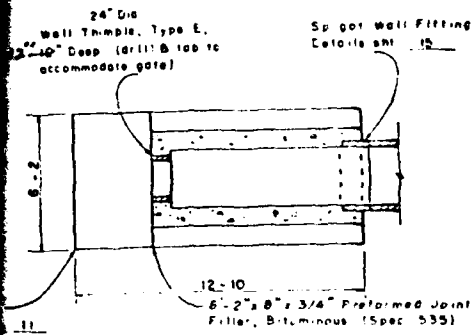


PLATE CONSTR. JOINT

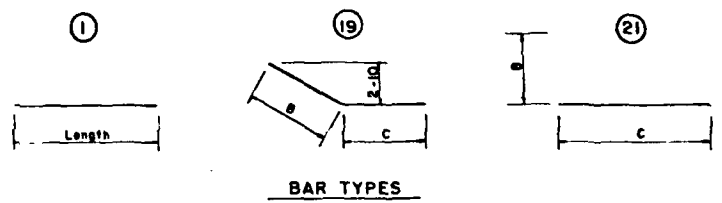
CONSTRUCTION NOTES

1. PORTLAND CEMENT TYPE I-A OR I WITH AN AIR-ENTRAINING ADMIXTURE SHALL BE USED.
2. WHEN NOT OTHERWISE SHOWN THE THICKNESS OF CONCRETE OVER REINFORCING STEEL SHALL BE 2\"/>



STEEL SCHEDULE

BAR	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
B 1	5	10	5-9	1			57-6
B 2	5	7	8-9	1			61-3
B 3	5	12	8-9	21	3-0	5-9	57-6
B 4	5	6	8-9	1			52-6
B 5	5	2	8-9	1			8-0
B 6	5	2	8-9	1			51-9
B 7	5	2	8-9	1			1-6
B 8	5	11	8-9	21	1-0	5-9	31-2
B 9	5	8	8-9	21	1-0	5-9	31-2
B 10	5	1	8-9	1			6-9
B 11	5	1	8-9	1			13-0
B 12	5	1	8-9	1			6-9
B 13	5	1	8-9	1			6-9
B 14	5	12	8-9	21	0-6	5-3	46-0
B 15	5	12	8-9	21	2-9	5-3	38-0
B 16	5	1	8-9	1			35-0
B 17	5	8	8-9	1			4-6
B 18	5	8	8-9	1			21-0
B 19	5	8	8-9	1			24-0
B 20	5	12	6-0	1			72-0
B 21	5	8	7-0	1			56-0
B 22	5	16	8-3	1			132-0
B 23	5	16	3-3	1			52-0
B 24	5	10	7-0	1			70-0
B 25	5	36	8-0	21	2-9	5-3	288-0
B 26	5	12	6-3	1			75-0
B 27	5	1	7-8	1			28-0
B 28	5	1	12-6	1			50-0
B 29	5	1	18-0	1			72-0
B 30	5	1	18-9	1			75-0
B 31	5	6	8-6	19	6-9	1-9	66-0
B 32	5	1	8-6	1			21-0
B 33	5	1	8-6	1			21-0
B 34	5	1	8-6	1			21-0
B 35	5	16	8-6	1			38-0
B 36	5	16	8-6	1			80-0
B 37	5	6	8-6	1			52-6
B 38	5	36	8-9	1			288-0
B 39	5	1	8-9	1			20-0
B 40	5	12	17-9	1			225-0
B 41	5	1	7-9	1			62-0



QUANTITIES

CONCRETE	Class 4000 (riser only)	19.5	cu yds
STEEL	no 5 bars	2615.5	lbs.
	no 7 bars	181.8	lbs.
	Total	3099	lbs.

AS BUILT PLANS

NOT TO SCALE

BRANDYWINE CREEK WATERSHED
FLOODWATER RETARDING DAM PA-433
CHESTER COUNTY, PENNSYLVANIA
RISER

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Date: 10-72
Project: CRISE
Drawing No: 10-72
Scale: 1/4" = 1'-0"

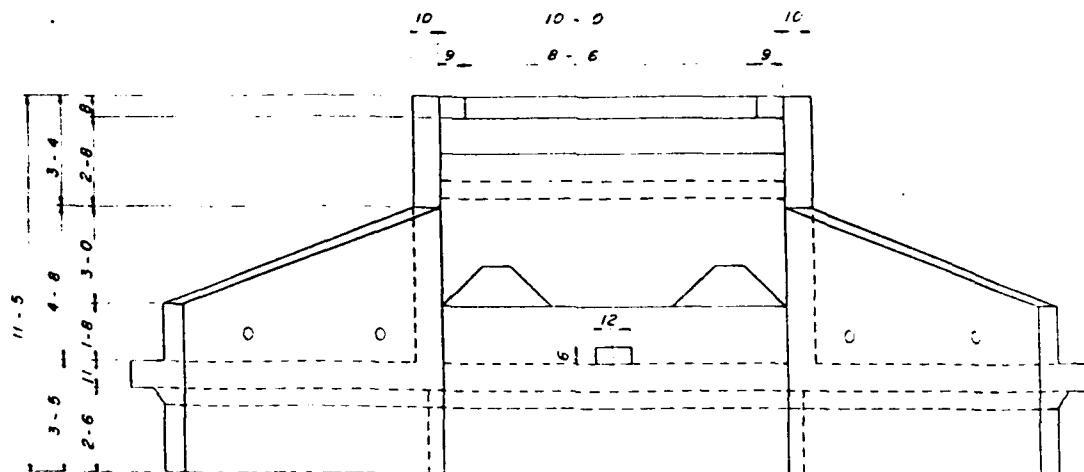
PLATE 9
PA-433-P

Note Last section
of conduit to
old horizontal

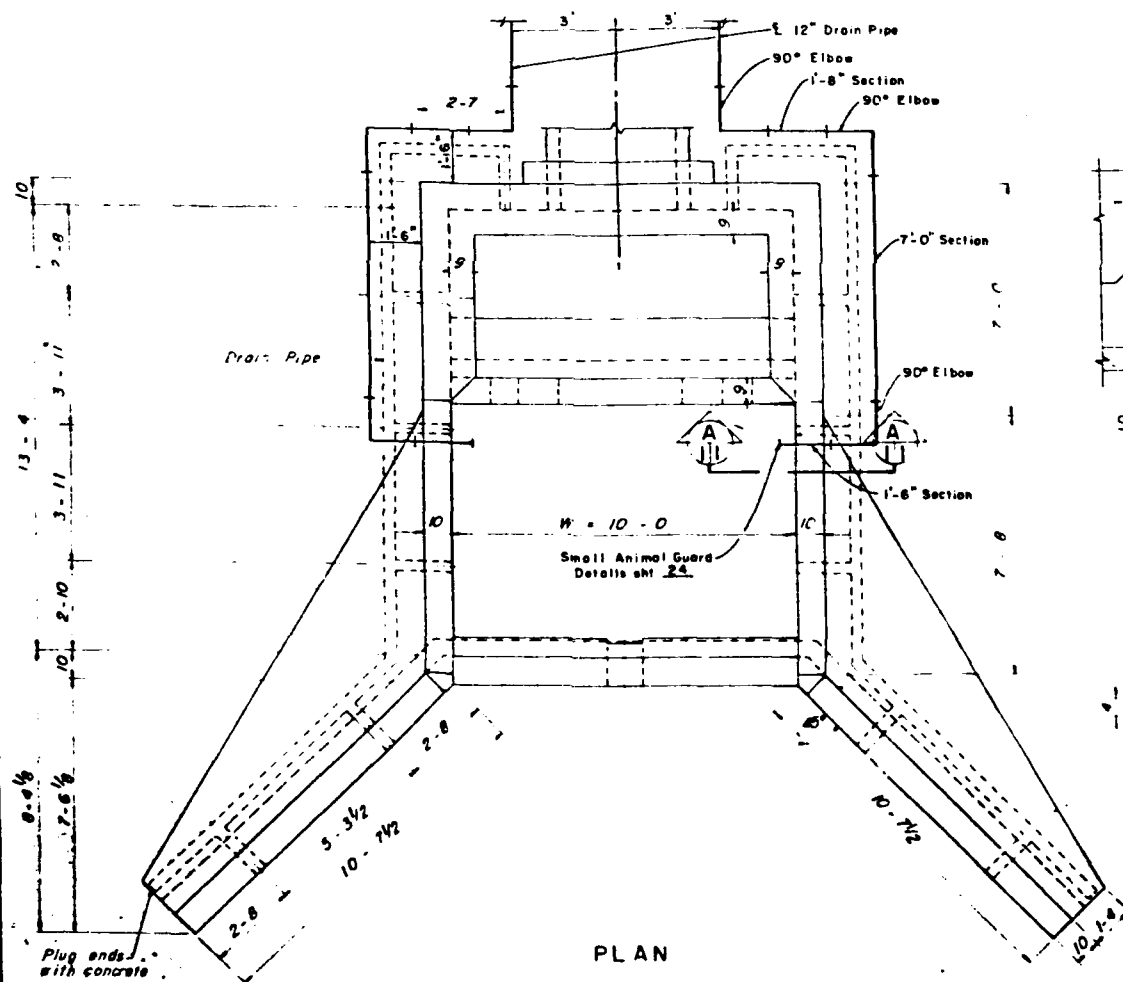
Page 10

Concrete
crodie

Compressible
(Styrofoam)



DOWNSTREAM ELEVATION



SECTION A
III
NOT TO SCALE

PLAN - JUNCTION
SIDEWALL AND
WINGWALL
NOT TO SCALE

STANDARD IMPACT BASIN	
DESIGN CONSTANTS	$f_c = 4,000 \text{ psi}$ $n = 8$
	$f_c = 116.00 \text{ psi}$ $f_s = 20,000 \text{ psi}$
STANDARD DRAWING NO.	ES-4100
DATE: 1-70	SHEET 1 OF 8

CARL ROMDE
Consulting Engineer
654 Ridgeway Rd. Los Angeles, Ore

SCALE IN FEET
EXCEPT AS NOTED

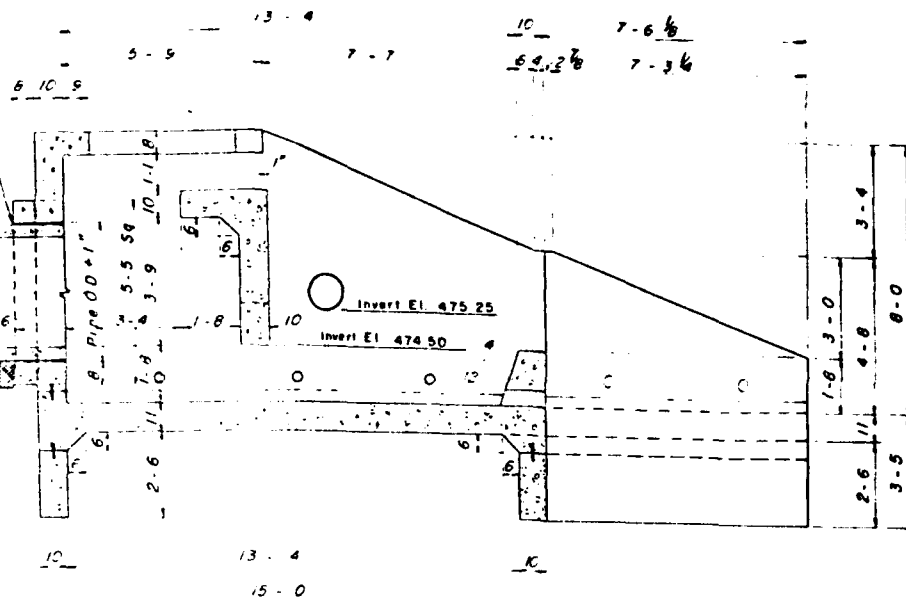
1/2" perforated joint filler
Type 2, Spec 835

Note: Last section
of conduit to be
laid horizontal

Pipe ID
30"

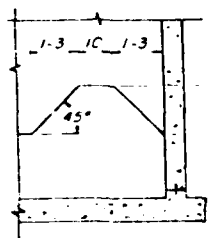
Concrete
grade

Compressible material
(Styrofoam)



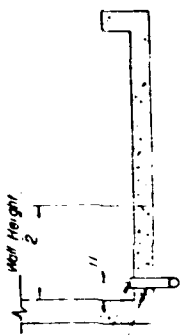
SECTION ON CENTERLINE

headwall
(wingwall and toe wall similar)



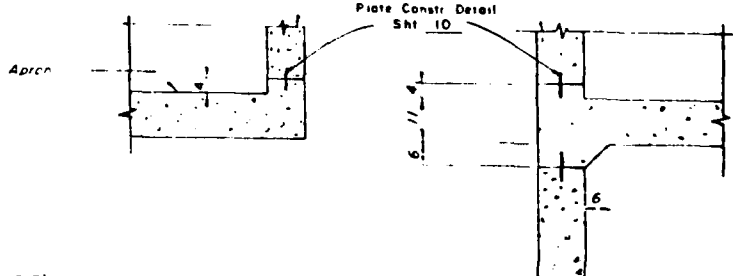
SECTION

NOT TO SCALE



SECTION THROUGH DRAIN & FILTER

NOT TO SCALE



CONSTRUCTION JOINT DETAILS

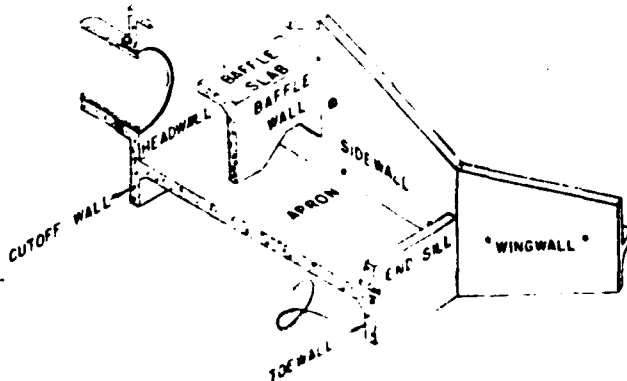
NOT TO SCALE

AS BUILT PLANS

QUANTITIES

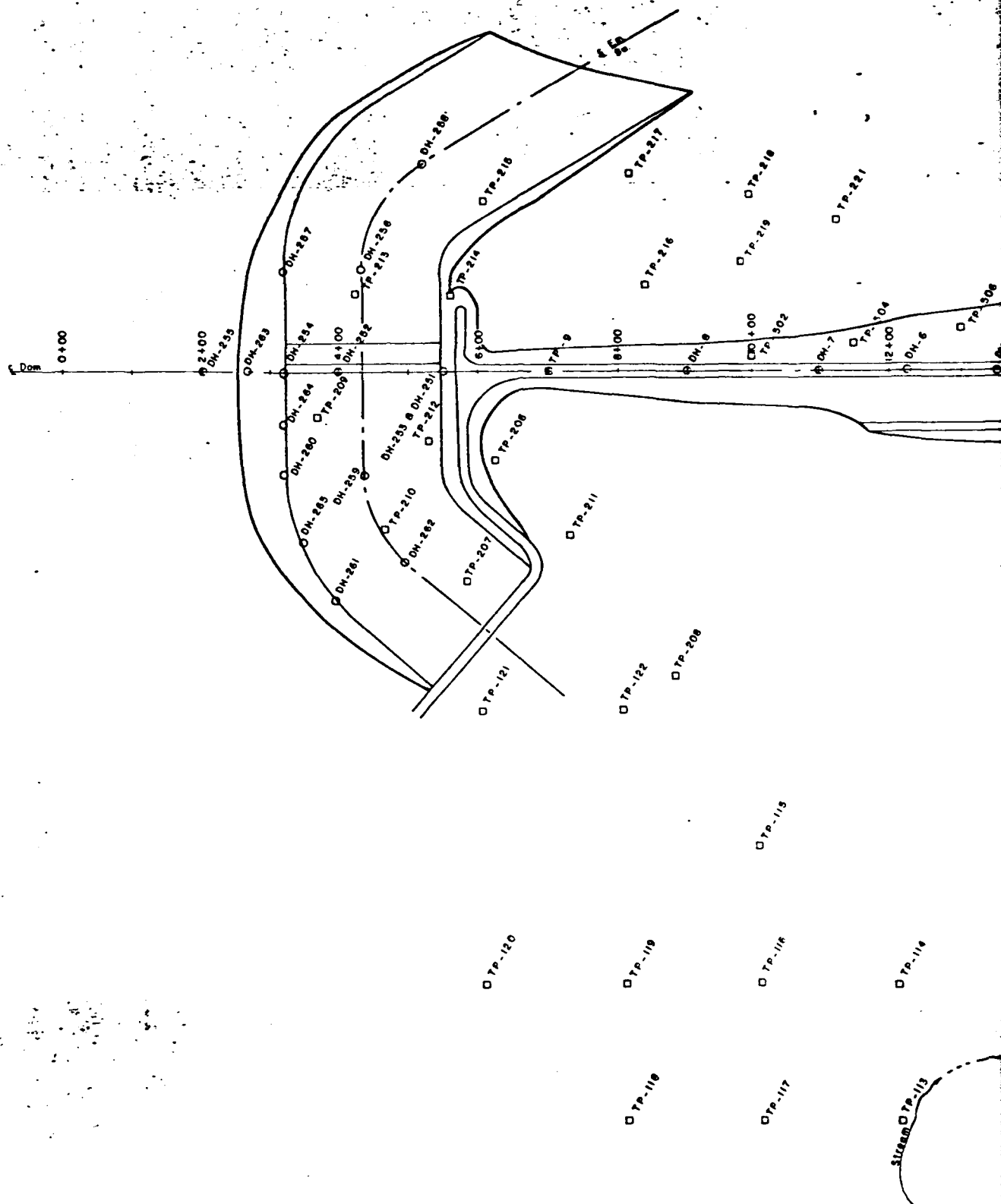
Reinforced Concrete	20 8' Cu Yd
Reinforcing Steel	3932' lbs
Drainage	
4" Perforated drain pipe (Spec 845, ASTM C-508) 80' Lin Ft	
Animal screen detail, sheet 17	12 00
Drain pipe tee for old 8" T branch	10 00
Drain pipe 90° ell	4 00
Drain pipe 45° ell	2 00
4" asbestos cement, perforated, underdrain pipe shall be used	
Joints	
1/4" x 6" Carbon steel plate, Structural grade	620 00

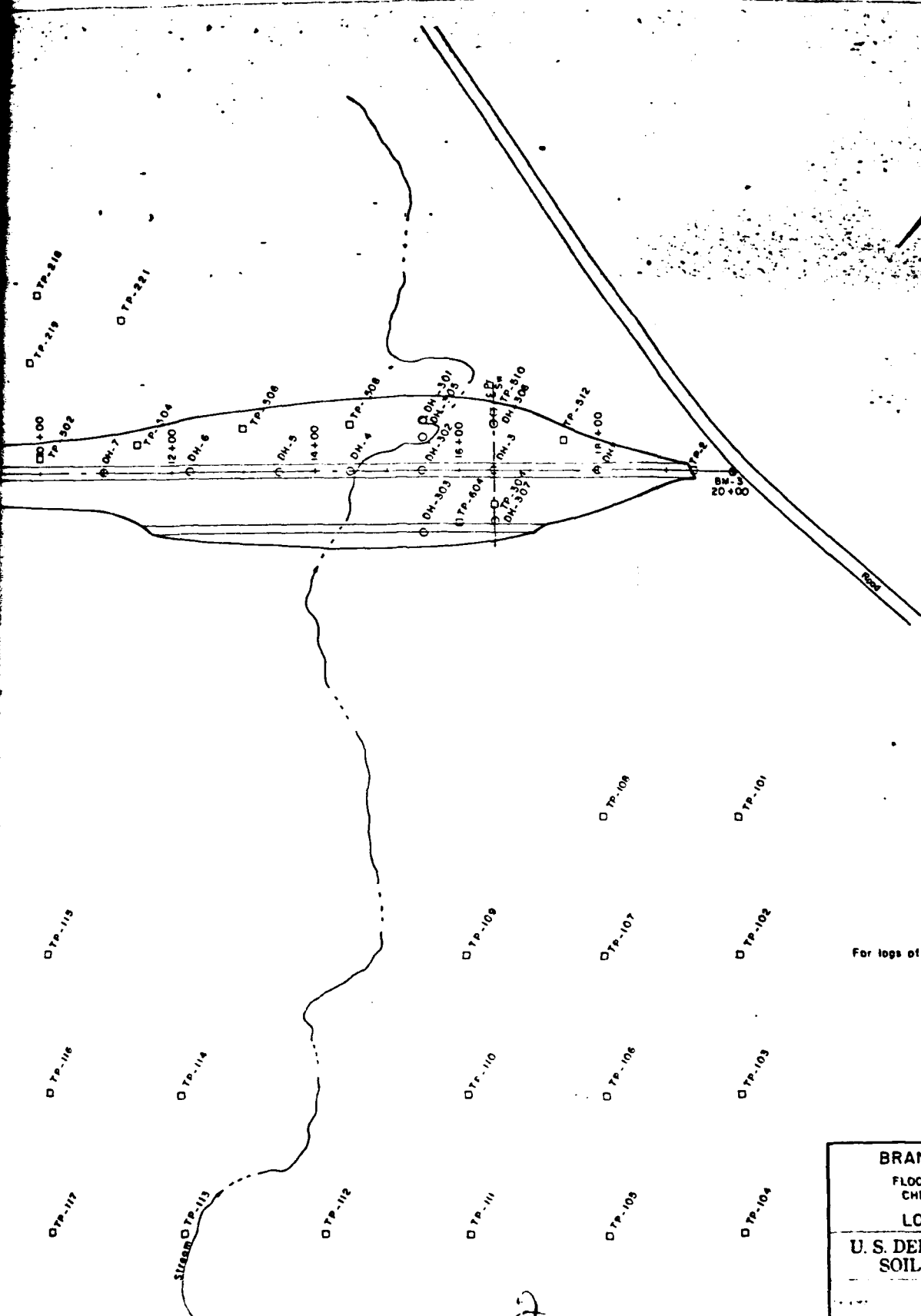
PLAN - JUNCTION
SIDEWALL AND
WINGWALL
NOT TO SCALE



ISOMETRIC VIEW

BRANDYWINE CREEK WATERSHED FLOODWATER RETARDING DAM PA-433 CHESTER COUNTY, PENNSYLVANIA IMPACT BASIN	
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
Date	Approved By
Drawn By	Checked By
Scale	Sheet
PA-433-P	





For logs of test holes see sheets 26 thru 32.

AS BUILT PLANS

BRANDYWINE CREEK WATERSHED	
FLOODWATER RETARDING DAM PA-433	
CHESTER COUNTY, PENNSYLVANIA	
LOCATION OF TEST HOLES	
U. S. DEPARTMENT OF AGRICULTURE	
SOIL CONSERVATION SERVICE	
DATE	1-74
CIRISE	3-74
PA-433-P	

PLATE 11

ENTRANCE - 100' 0" 100' 0" 100' 0"
 LOGGED BY - R. C. FREAS 3-22-71
 DRILLING EQUIPMENT - JOHN DEERE BACKHOE

HOLE DEPTH		DESCRIPTION OF MATERIALS	UNIT SOIL CLASS SYMB	STANDARD PENETRATION		TEST		DEPTH		% REC.
FROM	TO			TYPE	BLWS PER FT	TEST	FROM FT.	TO FT.		
0.0	0.7	TOPSOIL - DARK, MOIST, ETC.		2-2-3	SPT	1	JAR	0.0	0.7	99
0.7	3.5	SILT, SANDY - ORANGE, VERY MOIST, VERY SLIGHT PLASTIC, SOFT TO FIRM, TRACE GRAVEL, 35 PERCENT SAND, 70 PERCENT FINES, SAND W/ 1% FINE GRAINED, SAND CONTENT VARIABLE, WITH MAX 45 PERCENT.	ML	2-2-3	"	2	"	0.7	3.5	87
				4-10-20	"	3	"	1.0	4.5	93
				18-34-20	"	4	"	4.5	6.0	87
3.5	6.0	SAND, SILTY - ORANGE, DARK, MICACEOUS, NONPLASTIC, FIRM, HEAVY, 10 PERCENT GRAVEL, 55 PERCENT SAND, 35 PERCENT FINES, LOCALLY ONLY 20 PERCENT FINES.	SM	17-27-36	"	5	"	6.0	7.5	67
				37-42-56	"	6	"	7.5	9.0	50
				37-31-83-88	"	7	"	9.0	11.5	47
6.0	18.0	SAPROLITE - TAN TO WHITE, BANDED, MOIST, NONPLASTIC, LOCALLY MICACEOUS, 35 PERCENT GRAVEL, 60 PERCENT SAND, 25 PERCENT FINES, LOCALLY FINES ONLY 15 PERCENT, BECOMES NOTABLY MORE FIRM WITH DEPTH, A REACH 12.0' HAD TO USE 300 LB. HAMMER.	SM	50-73-105	"	8	"	11.5	13.5	70
				DIA				13.5	16.0	0
				SPT	9	JAR		16.0	17.0	80
				DIA				17.0	19.0	25
18.0	20.5	QUARTZ MONZONITE - WHITE TO LT. GRAY WITH DR. GRAY & GREENISH GRAY STREAKS, HIGHLY WEAR, AGING, MUSTY STAINING COMMON, DRILLED WITH HARD & SOFT LAYERS, MOSTLY FINE SAND, 20 PERCENT FINES, THIS IS RESIDUAL OVER QUARTZ ZONITE, REFUSAL AT 9.45'.						19.0	23.5	0
								23.5	26.5	50
20.5		BOTTOM OF HOLE, WL (3-23-71) 0.41.								

WATER HAMMER USED

TP-2, ELEV. 517.9, 100' 0" 100' 0"
 LOGGED BY - R. C. FREAS 3-22-71
 DRILLING EQUIPMENT - JOHN DEERE BACKHOE

HOLE DEPTH FROM TO	DESCRIPTION OF MATERIALS	UNIT SOIL CLASS SYMB	STANDARD PENETRATION TYPE BLWS PER FT USED	NO.	TYPE	FROM FT.	TO FT.	% REC.
0.0 0.9	TOPSOIL - BLACK, ACIDS, ETC.							
0.9 4.7	SILT, SANDY - ORANGE TO TAN, MOIST, VERY SLIGHTLY PLASTIC, TRACE GRAVEL 30 PERCENT SAND, 70 PERCENT FINES, SAND CONTENT VARIABLE, GOES UP TO 45 PERCENT.	ML						
4.7 7.0	SAND, SILTY - LT. TAN, VERY SLIGHTLY MOIST, NONPLASTIC, MICACEOUS, 5 PERCENT GRAVEL, 65 PERCENT FINE SAND, 10 PERCENT FINES.	SM						
7.0 9.4	SAND, SILTY - VERY LT. TAN WITH WHITE TO GRAY, VERY SLIGHTLY MOIST, NONPLASTIC, 5 PERCENT LARGER THAN 3", MAXIMUM 15 PERCENT GRAVEL, 50 PERCENT FINE SAND, 20 PERCENT FINES, THIS IS RESIDUAL OVER QUARTZ ZONITE, REFUSAL AT 9.45'.	SM						
9.4	BOTTOM OF HOLE, DRY							

DN-3, ELEV. 480.3, 100' 0" 100' 0"
 LOGGED BY - R. C. FREAS 3-22-71
 DRILLING EQUIPMENT - S & H - NO. 1, CHILL RIG

HOLE DEPTH FROM TO		DESCRIPTION OF MATERIALS	UNIT SOIL CLASS SYMB.	STANDARD PENETRATION TYPE BLWS PER FT. USED	NO.	TYPE	FROM FT.	TO FT.	% REC.	
0.0	2.0	SILT - LT. TO MED. GRAY WITH MUSTY & BECOMING TAN TO GRAY BELOW 1 FT. MOTTLED, VERY SOFT, NONPLASTIC, HUMIC ODOR.	ML	1-3	SPT	1	JAR	0.0	2.5	52
				10-26-46	"	2	"	2.5	4.0	83
2.0	3.1	SILT, SANDY, ORGANIC - DR. GRAY TO BLACK, VERY SOFT, NONPLASTIC, 25 PERCENT FINE SAND, 75 PERCENT FINES, CONTAINS ABOUT 15 PERCENT ORGANIC MATERIAL.	ML	40-45-18	"	3	"	4.0	5.5	94
				20-24-20	"	4	"	5.5	7.0	94
				20-30-46	"	5	"	7.0	8.5	67
3.1	3.9	GRAVEL, SANDY - LT. TAN, WET, FIRM, NONPLASTIC, 55 PERCENT GRAVEL, 30 PERCENT SAND, 15 PERCENT FINES, GRAVEL IS FINE GRAINED, SUBANGULAR TO SUBROUNDED, ALLUVIAL.	GM	34-70-105	"	6	"	8.5	10.0	34
				30-40-52-60	"	7	"	10.0	12.0	34
				20-34-48-56	"	8	"	12.0	14.0	47
3.9	30.0	SAPROLITE - TAN, GRAY, & WHITE WITH DR. STREAKS, MOIST, VERY FIRM, USED 300 LB. HAMMER BELOW 14 FEET, WEAR, TO SM WITH WEAR, TO COARSE SAND, WEAR, IN PLACE FROM QUARTZ MONZONITE, THIS MATERIAL IS VERY SOLID & ALMOST IMPOSSIBLE TO SAMPLE WITH SPT, TOO DECOMPOSED TO DRILL.		8-30-105	"	9	"	14.0	16.5	34
				15-15-20	"	10	"	16.5	20.0	0
				42-36-47-83	"	11	JAR	20.0	22.0	84
				40-130	"	12	"	22.0	23.0	30
30.0	40.0	QUARTZ MONZONITE - LT. GRAY TO WHITE WITH DR. GRAY & GREENISH GRAY STREAKS, VERY HIGHLY WEAR, & AGING, PERCENT TO 34.0', ROCK IS ALMOST TOO WEAR, TO CORE, 34.0' NO. 1, 34.0' NO. 2, 34.0' NO. 3, 34.0' NO. 4, 34.0' NO. 5, 34.0' NO. 6, 34.0' NO. 7, 34.0' NO. 8, 34.0' NO. 9, 34.0' NO. 10, 34.0' NO. 11, 34.0' NO. 12, 34.0' NO. 13, 34.0' NO. 14, 34.0' NO. 15, 34.0' NO. 16, 34.0' NO. 17, 34.0' NO. 18, 34.0' NO. 19, 34.0' NO. 20, 34.0' NO. 21, 34.0' NO. 22, 34.0' NO. 23, 34.0' NO. 24, 34.0' NO. 25, 34.0' NO. 26, 34.0' NO. 27, 34.0' NO. 28, 34.0' NO. 29, 34.0' NO. 30, 34.0' NO. 31, 34.0' NO. 32, 34.0' NO. 33, 34.0' NO. 34, 34.0' NO. 35, 34.0' NO. 36, 34.0' NO. 37, 34.0' NO. 38, 34.0' NO. 39, 34.0' NO. 40, 34.0' NO. 41, 34.0' NO. 42, 34.0' NO. 43, 34.0' NO. 44, 34.0' NO. 45, 34.0' NO. 46, 34.0' NO. 47, 34.0' NO. 48, 34.0' NO. 49, 34.0' NO. 50, 34.0' NO. 51, 34.0' NO. 52, 34.0' NO. 53, 34.0' NO. 54, 34.0' NO. 55, 34.0' NO. 56, 34.0' NO. 57, 34.0' NO. 58, 34.0' NO. 59, 34.0' NO. 60, 34.0' NO. 61, 34.0' NO. 62, 34.0' NO. 63, 34.0' NO. 64, 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800, 34.0' NO. 801, 34.0' NO. 802, 34.0' NO. 803, 34.0' NO. 804, 34.0' NO. 805, 34.0' NO. 806, 34.0' NO. 807, 34.0' NO. 808, 34.0' NO. 809, 34.0' NO. 810, 34.0' NO. 811, 34.0' NO. 812, 34.0' NO. 813, 34.0' NO. 814, 34.0' NO. 815, 34.0' NO. 816, 34.0' NO. 817, 34.0' NO. 818, 34.0' NO. 819, 34.0' NO. 820, 34.0' NO. 821, 34.0' NO. 822, 34.0' NO. 823, 34.0' NO. 824, 34.0' NO. 825, 34.0' NO. 826, 34.0' NO. 827, 34.0' NO. 828, 34.0' NO. 829, 34.0' NO. 830, 34.0' NO. 831, 34.0' NO. 832, 34.0' NO. 833, 34.0' NO. 834, 34.0' NO. 835, 34.0' NO. 836, 34.0' NO. 837, 34.0' NO. 838, 34.0' NO. 839, 34.0' NO. 840, 34.0' NO. 841, 34.0' NO. 842, 34.0' NO. 843, 34.0' NO. 84								

BRANDYWINE CREEK WATERSHED
FLOODWATER RETARDING DAM NO. 2
CHESTER COUNTY, PENNSYLVANIA

LOG-13

HOLE DEPTH
FROM TO

STANDARD PENETRATION
TYPE
BLWS PER 6"

0.0 0.5
SILT, SANDY - ORANGE BRN & GRN, MOIST, MOTTLED, FIRM, SLIGHTLY PLASTIC, 10 PERCENT GRAVEL, 30 PERCENT SAND, 60 PERCENT FINES, GRAVEL UP TO 1/4 DIA.
0.5 1.0
SAND, SILTY - TAN TO BUFF WITH GRN, BRN, ORANGE, & BLACK STREAKS & BANDS, VERY MOIST, NONPLASTIC, VERY FIRM, 10 PERCENT GRAVEL, 65 PERCENT SAND, 25 PERCENT FINES, THIS S. SAPROLITE.
1.0 2.0
QUARTZ MONZONITE - 1/4" GRN TO WHITE, VERY FIRM TO HARD, PARTIALLY DECOMPOSED, HQD FROM 15.0-15.0' & HQD 60 PERCENT BELOW 15.0'. CORE BREAKS ALONG SOFT SLAMS VERTICAL & AT ANGLES, BROKEN SURFACES RUST & BLACK STAINED, FRAGMENTS SAND & GRAVEL SIZE < 0.5' TO 0.6' LONG. BOTTOM OF HOLE. WL (A-1-71) 5.2'.

2-2-5 SPT 1 JAR 0.0 1.5 40
2-2-5 " 2 " 1.5 3.0 84
7-7-11 " 3 " 3.0 4.5 72
8-6-9 " 4 " 4.5 6.0 81
7-9-11-15 " 5 " 6.0 8.0 65
14-15-22-65 " 6 " 8.0 20.0 63
BC-14-5-0-110 " 7 " 10.0 12.0 55
45-65 " 8 " 12.0 13.0 64
DIA " ARM 13.0 15.0 80
32-6-87-117 " 12 " 20.0 22.0 82

DRILLING EQUIPMENT - S & M - 400 (TRUCK)

HOLE DEPTH
FROM TO

STANDARD PENETRATION
TYPE
BLWS PER 6"

0.0 1.0
SILT, SANDY - ORANGE BRN & GRN, MOIST, FIRM, SLIGHTLY PLASTIC, 10 PERCENT GRAVEL, 30 PERCENT SAND, 60 PERCENT FINES, GRAVEL UP TO 1/4 DIA.

5 3 U 1.0 3.0 100

LOGGED BY - R. C. FREAS
DRILLING EQUIPMENT - S & M - 400 (TRUCK)

HOLE DEPTH
FROM TO

STANDARD PENETRATION
TYPE
BLWS PER 6"

0.0 0.7
TOPSOIL
0.7 4.0
SILT, SANDY - ORANGE BRN & GRN, MOIST, FIRM, SLIGHTLY PLASTIC, 10 PERCENT GRAVEL, 30 PERCENT SAND, 60 PERCENT FINES, GRAVEL UP TO 1/4 DIA.
4.0 13.0
SAND, SILTY - TAN TO BUFF WITH GRN, BRN, ORANGE, & BLACK STREAKS & BANDS, VERY MOIST, NONPLASTIC, VERY FIRM, 10 PERCENT GRAVEL, 65 PERCENT SAND, 25 PERCENT FINES, THIS S. SAPROLITE.
13.0 20.0
QUARTZ MONZONITE - 1/4" GRN TO WHITE, VERY FIRM TO HARD, PARTIALLY DECOMPOSED, HQD FROM 15.0-15.0' & HQD 60 PERCENT BELOW 15.0'. CORE BREAKS ALONG SOFT SLAMS VERTICAL & AT ANGLES, BROKEN SURFACES RUST & BLACK STAINED, FRAGMENTS SAND & GRAVEL SIZE < 0.5' TO 0.6' LONG. BOTTOM OF HOLE. WL (A-1-71) 5.2'.

1-1-5 SPT 1 JAR 0.0 1.5 40
2-2-5 " 2 " 1.5 3.0 84
7-7-11 " 3 " 3.0 4.5 72
8-6-9 " 4 " 4.5 6.0 81
7-9-11-15 " 5 " 6.0 8.0 65
14-15-22-65 " 6 " 8.0 20.0 63
BC-14-5-0-110 " 7 " 10.0 12.0 55
45-65 " 8 " 12.0 13.0 64
DIA " ARM 13.0 15.0 80
32-6-87-117 " 12 " 20.0 22.0 82

LOGGED BY - R. C. FREAS
DRILLING EQUIPMENT - S & M - 400 (TRUCK)

HOLE DEPTH
FROM TO

STANDARD PENETRATION
TYPE
BLWS PER 6"

0.0 0.5
TOPSOIL
0.5 2.9
SILT, SANDY - ORANGE BRN TO RUSTY COLORED, MOIST, FIRM, SLIGHTLY PLASTIC, MICACEOUS, TRACE OF GRAVEL, 25 PERCENT SAND, 75 PERCENT FINES.
2.9 27.0
SAND, SILTY - ORANGE BRN TO RUSTY, MOIST, VERY FIRM, NONPLASTIC, TRACE GRAVEL, 75 PERCENT MFG. SAND, 25 PERCENT FINES, THIS S. SAPROLITE. MATERIAL SEEMS TO BE VERY UNIFORM THROUGHOUT IN TEXTURE. COMPOSITION, ANY COLOR, MATERIAL BECOMES INCREASINGLY FIRMER WITH DEPTH. USED 300 LB. HAMMER BELOW 15.0'. SLIGHTLY MICACEOUS THROUGHOUT. BOTTOM OF HOLE. WL (A-1-71) 10.9'.

2-4-6 SPT 1 JAR 0.0 1.5 73
3-8-10 " 2 " 1.5 3.0 67
8-13-24 " 3 " 3.0 4.5 60
8-12-14 " 4 " 4.5 5.5 67
17-20-2-36 " 5 " 5.5 7.0 67
30-30-4-58 " 6 " 7.0 9.0 55
22-31-33-57 " 7 " 9.0 11.0 40
28-24-34-35 " 8 " 11.0 13.0 50
16-20-27-48 " 9 " 13.0 15.0 50
25-50-74-115 " 10 " 15.0 17.0 50
10-14-18-22 " 11 " 17.0 19.0 50
6-8-10-15 " 12 " 19.0 21.0 50
5-7-7-11 " 13 " 21.0 23.0 65

CONTINUED

NOTE - ALL SOIL AND ROCK CLASSIFICATIONS WERE DETERMINED BY VIAL - MANJA METHOD.

BRANDYWINE CREEK WATERSHED
FLOODWATER RETARDING DAM NO. 2
CHESTER COUNTY, PENNSYLVANIA
LOGS OF TEST HOLES

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLATE 12

LEGEND

TEST HOLE NUMBERING SYSTEM

Centerline of Dam	1 - 99
Borrow area	101 - 199
Emergency spillway	201 - 299
Centerline of outlet structure	301 - 399
Stream channel	401 - 499
Relief wells	501 - 599
	601 - 699
	701 - 799

UNIFIED SOIL CLASSIFICATION SYSTEM SYMBOLS

GW	Well graded gravels, gravel-sand mixtures
GP	Poorly graded gravels
GM	Silty gravels, gravel-sand-silt mixtures
GC	Clayey gravels, gravel-sand-clay mixtures
SW	Well graded sands, sand-gravel mixtures
SP	Poorly graded sands
SM	Silty sands, sand-silt mixtures
SC	Clayey sands, sand-clay mixtures
ML	Silts, silty, very fine sands, sandy or clayey silts
CL	Clays of low to medium plasticity; silty, sandy or gravelly clays
CH	Clays of high plasticity; fat clays
MH	Elastic silts, micaceous or diatomaceous silts
OL	Organic silts and organic silty clays of low plasticity
OH	Organic clays or silts of medium to high plasticity

BEDROCK SYMBOLS

B	Basalt	Sc	Schist
Gn	Gneiss	Sh	Shale
Gr	Granite	Ss	Siltstone
Ls	Limestone	Sl	Slate
Ma	Marble	Ss	Sandstone

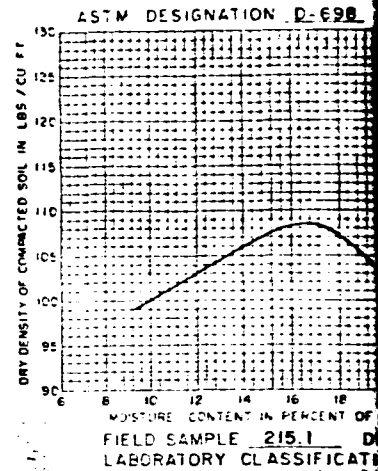
SAMPLES

DS	Disturbed
US	Undisturbed

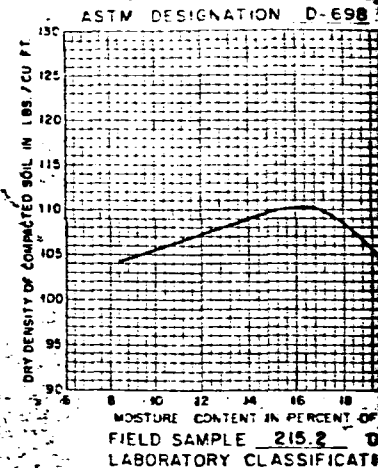
NOTE

All soil and rock classifications were determined by visual examination, except where otherwise noted.

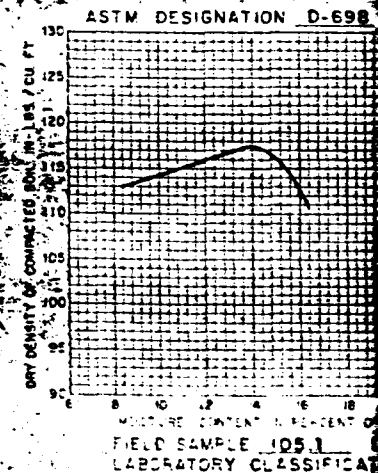
COMPACTION CURVE LABORATORY SAMPLE NO.



COMPACTION CURVE LABORATORY SAMPLE NO.



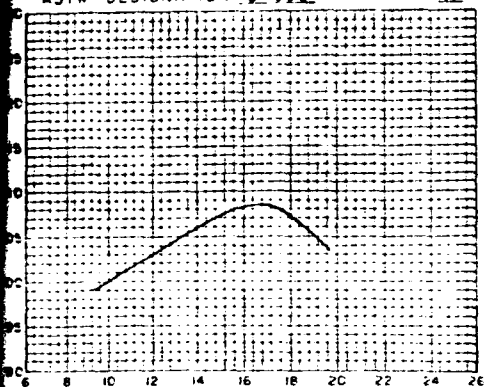
COMPACTION CURVE LABORATORY SAMPLE NO.



COMPACTION CURVE

LABORATORY SAMPLE NO 72W1254

ASTM DESIGNATION D-698 METHOD A

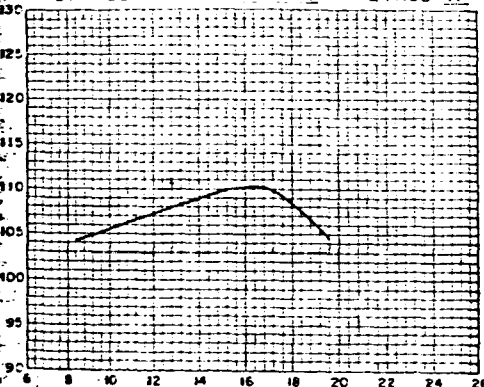


FIELD SAMPLE 215.1 DEPTH 10'-30'
LABORATORY CLASSIFICATION CL

COMPACTION CURVE

LABORATORY SAMPLE NO 72W1255

ASTM DESIGNATION D-698 METHOD A

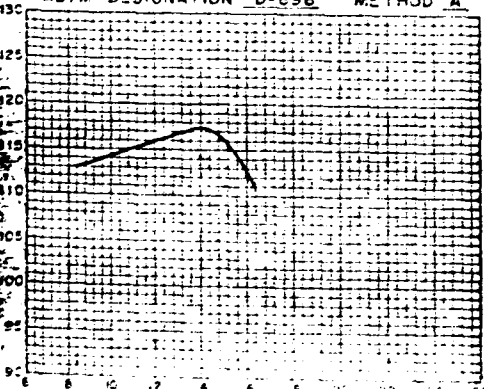


FIELD SAMPLE 215.2 DEPTH 10'-30'
LABORATORY CLASSIFICATION SM

COMPACTION CURVE

LABORATORY SAMPLE NO 72W1256

ASTM DESIGNATION D-698 METHOD A

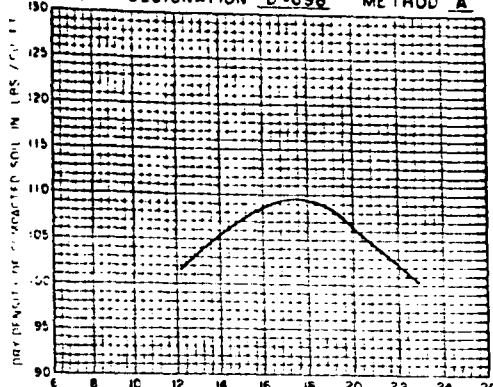


FIELD SAMPLE 105.1 DEPTH 30'-6.5'
LABORATORY CLASSIFICATION SM

COMPACTION CURVE

LABORATORY SAMPLE NO 72W1257

ASTM DESIGNATION D-698 METHOD A

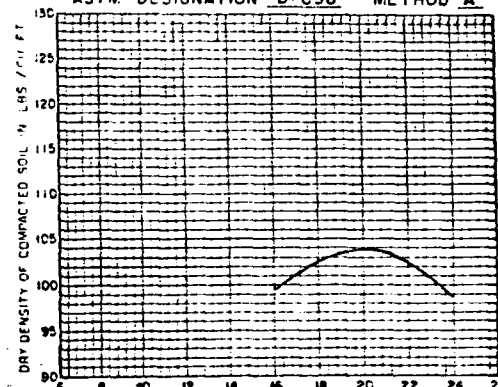


FIELD SAMPLE 106.1 DEPTH 0'-30'
LABORATORY CLASSIFICATION ML

COMPACTION CURVE

LABORATORY SAMPLE NO 72W1258

ASTM DESIGNATION D-698 METHOD A



FIELD SAMPLE 116.1 DEPTH 0'-2.5'
LABORATORY CLASSIFICATION ML

2

BRANDYWINE CREEK WATERSHED

FLOODWATER RETARDING DAM PA-433

CHESTER COUNTY, PENNSYLVANIA

COMPACTION DATA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Project	Date
CRISE	10-72
Drawn	Checked
By	By
Scale	3-74
Plate	PA-433-P

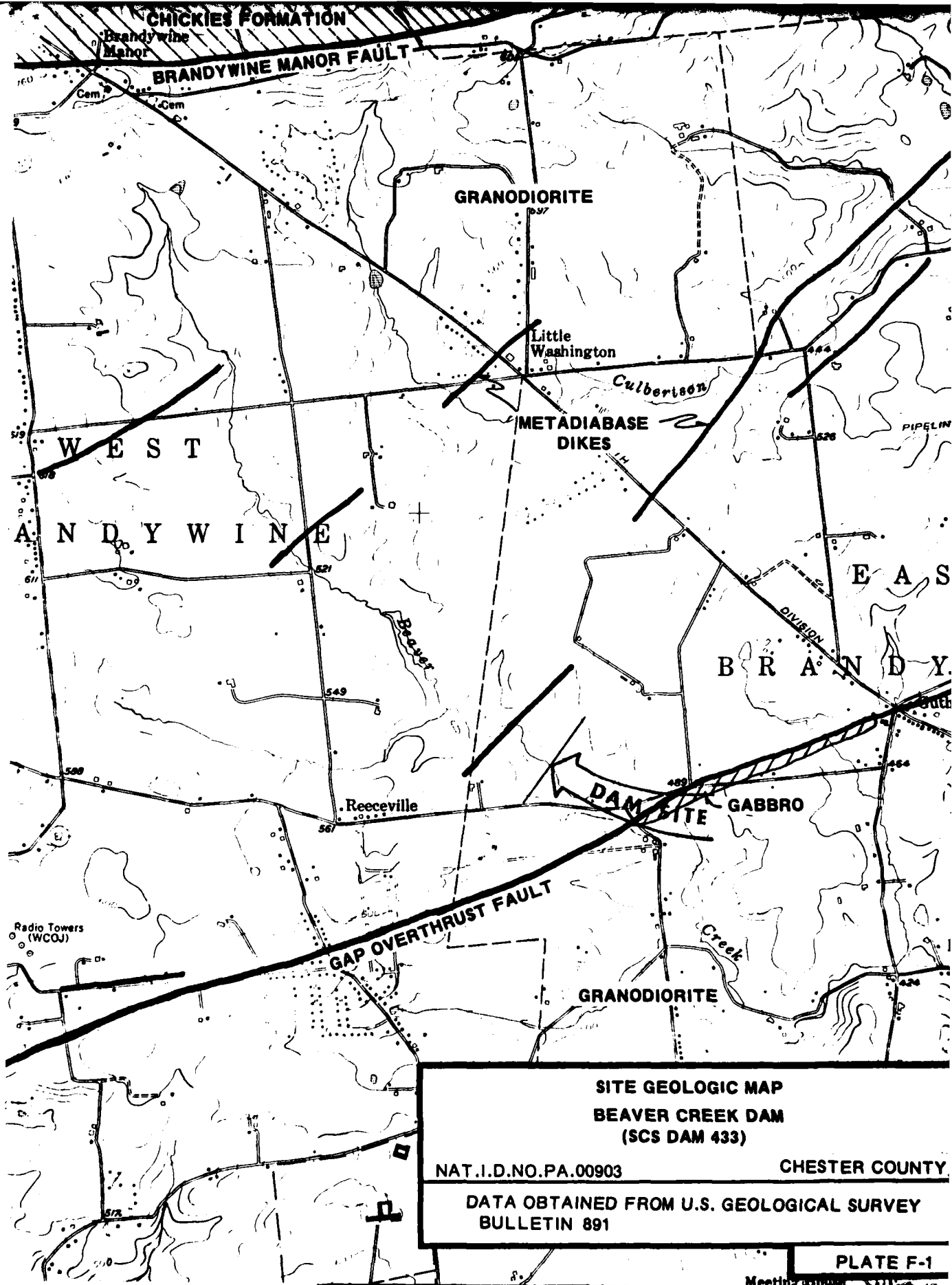
PLATE 13

APPENDIX

F

SITE GEOLOGY
BEAVER CREEK DAM
(SCS PA 433)

Beaver Creek Dam is located in the Piedmont Uplands Section of the Piedmont Physiographic Province. As shown on Plate F-1, the area surrounding the dam consists predominantly of a granite like rock called granodiorite (referred to as quartz monzonite in the files of the Department of Environmental Resources in Harrisburg). Throughout the area, minor amounts of pegmatite and metadiabase occur as dikes. No bedrock exposures were observed during the field inspection, but the original geology report describes steeply dipping "flow structures" in the weathered bedrock and saprolite, encountered during the Soil Conservation Service site investigation. Granodiorite is a dense igneous rock usually having variable thickness of weathered or decomposed surficial material above the sound bedrock. Several regional east-northeasterly striking thrust faults occur in the area, one being about 1,200 feet to the north and the other about 1,000 feet to the south of the right abutment.



**SITE GEOLOGIC MAP
BEAVER CREEK DAM
(SCS DAM 433)**

NAT. I.D. NO. PA.00903

CHESTER COUNTY

DATA OBTAINED FROM U.S. GEOLOGICAL SURVEY
BULLETIN 891

PLATE F-1

Meeting with ...

END 6-80